ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLVI. No. 15. NEW YORK, SATURDAY, APRIL 15, 1905. ISSUED WEEKLY

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PUBLISHING OFFICE . . . . . 13-21 Park Row, New York
WESTERN OFFICE: Fisher Building, Chicago, Ill. . LUCIEN W. MARSHALL, Manager
BOSTON OFFICE: 161 Devonshire Street . . . . . M. W. BARBER, Manager
EUROPEAN OFFICE: 42 Old Broad Street, London, E. C. . . HENRY W. HALL, Manager

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview." New York.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single Copies, each 10

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ELECTROLYSIS OF PLATINUM.

Platinum is generally considered to be an ideal electrode for electrolytic processes in which the electrodes play no part. It is a good conductor, it does not oxidize, and is generally thought to be unaffected by electrolysis. This is true so long as the current flowing from the electrode does not vary, but, if it vary, electrolysis may take place, although ordinarily there would be no reaction between the conducting solution and the metal. This phenomenon has been investigated recently by Messrs. A. Brochet and J. Tiet, the electrolyte in this case being sulphuric acid. The action took place whether an alternating current or a varying direct current was used. No explanation of this peculiar action is offered. It has been known for some time that metals could be dissolved electrolytically by means of an alternating current, the explanation offered being that, while the greater part of the metal dissolved during one-half of the wave was redeposited during the next half-wave, some managed to get out of reach of the electrode, as it were, and remained in solution; but the action of platinum is not similar to this, for platinum itself is not dissolved by a direct current, but dissolves only when the current varies.

It is interesting to note, while speaking of platinum, that the United States Geological Survey purposes undertaking an investigation of the different sources of this metal in this country. We produce but a small fraction of the platinum which we consume yearly, and the discovery of important deposits of this valuable metal would be welcomed. For many purposes it is indispensable, and were it not so expensive, it would be more widely used. The records of the United States Geological Survey show that during the year 1903—the latest year for which complete figures are available—this country produced only 110 ounces of platinum, valued at $2,080. The quantity of platinum imported into the country was valued at $2,055,933—about one thousand times as much as we produced.

A PERTINACIOUS CURRENT.

While laboring to develop a practical method of dispersing fog, Sir Oliver Lodge has carried out some interesting physical investigations and arrived at some conceptions of what is taking place during certain phenomena, which he puts forward to explain actions not previously understood. It will be remembered that Sir Oliver has endeavored to apply, on a large scale, the effects of a high-voltage brush discharge of electricity on fogs. It has been known for a long time that the action of such discharges on mists was to cause the minute particles of water to coalesce into drops when they were precipitated, leaving the air clear. The work was at first carried on in the laboratory on a small scale, but he has made some tests out of doors, with what was reported to be fair success. The latter tests were conducted at Birmingham University, and it was reported that a considerable space around the discharging wire was cleared of the fog.

The difficulties of applying such a system to everyday purposes are great. One of these is, of course, the cost of an equipment of this kind, which would be in use but a short time. Another has been the devising of means of obtaining a satisfactory supply of electricity. What is needed is a direct current of exceedingly high potential. This can be obtained from the well-known physical static machine, but such generators have only a small output. An induction coil gives the high pressure desired, but its discharge is not continuous. What has been done by Sir Oliver is to adapt the induction coil to his purpose. This has been done by causing the coil to charge condensers, which themselves supply the continuous discharge. To employ condensers in this way, it is necessary to place between them and the induction coil an interrupter or valve of some

kind, which would allow current to flow into the condensers from the coil, but would not allow it to flow back through the secondary coil, and thus discharge the condensers.

This arrangement was described by Sir Oliver at a recent meeting of the Royal Institution, of London, and an explanation given of his selection of the term "pertinacious" to describe the current obtained. The idea was to obtain a designation which would distinguish this flow from that given by the induction coil itself, and which would at the same time indicate somewhat the character of the current. As this current has an exceedingly high potential, it will flow through high resistances, or even across breaks in the circuit, hence the term "pertinacious."

Sir Oliver has not been satisfied with hunting for a suitable form of current, but has endeavored to derive some conception of the action of the rectifier which would picture to him what is actually going on. His idea is this: as is well known, one of the striking features of a Crookes tube, when subjected to a discharge, is the dark space surrounding the cathode, outside of which there is a blue glow reaching to the anode. As the vacuum is made higher, this dark space grows out, pushing before it the glow, until the whole tube becomes dark. Sir Oliver's idea is that this dark space is due to a discharge of negatively charged corpuscles from the cathode, which traveling at enormous speeds and in great numbers stop the positively charged particles which are flying from the anode. The higher the vacuum, the further do the negatively charged particles travel, and the longer is the dark space. When the dark space has completely filled the tube, the flow through it in the opposite direction stops, because the positively charged particles can not leave the anode, but are beaten back into it by the others.

These negatively charged particles do not necessarily travel toward the anode, but fly off in straight lines from the cathode; hence, if a tube be arranged so that they will not fall upon the anode, the flow of current will not be interrupted by them. If, then, a tube be arranged so that the discharge from one electrode is directed upon the other, but the discharge from the second does not fall upon the first, the tube becomes a rectifier, allowing the current to pass through it in one direction only. For this action to be continuous, it is necessary that there should be a continuous supply of ions. This is accomplished by making one of the electrodes of mercury, which maintains a definite vapor pressure in the tube, and thus keeps up the supply of carriers. The particular rectifier used by Sir Oliver Lodge is a Cooper Hewitt mercury-vapor lamp of the old form. This is placed vertically. It has an iron anode at the top, and a mercury cathode at the bottom. The outside of the bulb containing the mercury is wrapped with tinfoil and connected electrically to the anode. This forms a condenser, and the cathode rays of the mercury are drawn to the walls of the tube, leaving a free path for the positive carriers down the centre of the tube. Current can not pass through the tube in the opposite direction, because the discharge in that case from the cathode would be directed upon the anode below it.

ELECTRICITY IN MINES.

That electricity offers the best method of conducting the general work of a mine is pretty well demonstrated by the progress which has been made in the substitution of this power for others in the anthracite coal mines in the neighborhood of Scranton, Pa. The second article dealing with these equipments appears in this issue of the ELECTRICAL REVIEW, the first article appearing in the issue of April 8. From this description it will be seen that, after trying the electric motor, the superiority of electricity was evident, and the system is being extended as rapidly as possible to other mines in the vicinity. The situation is such that it has been possible to supply a number of mines with power from a single station, thus gaining considerably in the efficiency of station operation.

Both direct-current and alternating-current systems are in use. The latter has the advantage when transmission over some distance must be made. When it is used, however, and when electric locomotives are installed, it becomes necessary to convert a portion of the alternating current into direct current for the locomotive. This double transformation, while undesirable, is not a great drawback. We have become accustomed to it in railway operation. When direct currents are used it is unnecessary, but then the transmission problem is more troublesome. In these mines there is not much danger of explosion being caused by sparking.

The headway which electrical operation is making in this region is very encouraging to advocates of that system, particularly as it has been preceded by trials of mules, steam and compressed air. As compared with mule traction, there is a great saving in labor, as with the latter system each animal requires a driver, while a single locomotive can handle a long train of cars. As compared with compressed air, there is much saving in time and gain in efficiency. The compressed-air locomotive is being charged for about one-third of the time it is in operation. In addition to this, it is necessary to carry the air pipes through the mines—a work much more difficult and expensive than that of carrying in electrical conductors. While it might seem that the compressed-air locomotive had a greater flexibility of movement in that it was not tied down to an overhead conductor, the custom of attaching to each electric locomotive a long cable, which it unwinds and winds up as it moves, enables it to proceed some distance from the trolley wire, thus permitting it to move about as freely as the compressed-air locomotive. But more important than this is the fact that it can be kept at work constantly.

Another advantage of the electric system is the greatly improved lighting in the mines which it makes possible. It is becoming the custom to light the mines pretty thoroughly, since this greatly facilitates the work of the miners and of hauling. If the supply for the working motors and for the lights be drawn from the same station, so much the better; but there is so much gained by the use of electric lights that even were it not thought advisable to introduce the motor in place of the mule, there is little doubt that electric lighting would spread rapidly. However, a great part of the work in some of the mines, at least, is now being done by electric motors.

WHERE A CONSULTING ENGINEER IS NEEDED.

There is a certain class of people which looks upon the engineer as a great scientific expert—a man who has devoted years of study and hard work to learning thoroughly his profession, and whose services are indispensable when important work is to be done. But, to them, the engineer is a man of such importance that he will not stoop to small work. He perhaps would be out of his element if he did, and when a small job is to be done, there is little to be gained by employing expert advice.

Upon the other hand, there is another class of people—men who probably call themselves practical—who have done a good deal of work, who have learned what they know in the hard school of experience, and who think that they know all that is necessary for carrying out a small undertaking, and therefore do not need the services of a consulting engineer. There are many men in this class who have done a lot of work. Some of them have almost grown up with the electrical profession. For carrying out certain kinds of work, better men can not be found, but, in the broader sense of the word, they are not engineers. But few of them are capable of grasping the larger features even of a small undertaking, and for this reason they do not build wisely, although they build well. As a rule, they install a plant which will be reliable, but it is apt not to be efficient.

Of course, both of these classes are in the wrong. There are many engineers who are not only competent, but who would gladly do the consulting work for small plants, and whose advice and instructions would save, many times over, the fee charged. It must be a small job indeed, and a very unimportant one, which is not worth doing right. If it is to be done right, it must be done by a man who knows how to do it. A dynamo tender does not necessarily become a good designer, nor even a good operating engineer. There are very few linemen, if any, who know how to design a transmission line. The man who has learned his trade merely by doing what others have told him to do is very apt to follow precedent although conditions may call for something entirely new. If he has learned to raise poles by means of pikes, he will probably go on putting in poles in the same way until some one makes him do it in a different way. Until he has been shown that there are better ways than the one which he practises, he naturally thinks he knows the best way, and that he knows all there is to be known about raising poles. Only recently we were shown a letter received by an electrical engineer, which said that a certain electrical plant had no need of his abilities, because the writer, who was also the engineer of the plant, had done all the work himself, from the designing and laying out of the plans to installing the motors, putting in the poles, and hanging the wire. To strengthen his contention that the work was done as well as it could be, he told, somewhat in detail, how he had strung wire, planted poles and run dynamos in various parts of the world. He had been in the business for many years, and during that time had visited many countries. We are sorry to say that, with all his experience, his grammar seems to have stuck where it was when he left the primary school, leading one to infer that his engineering abilities had not been much developed. No doubt the plant erected by this man was thoroughly reliable. Probably it is giving satisfactory service; possibly it is paying well. But is it not more probable that a better plant could have been laid out by securing the services of a competent consulting engineer in the first case, or that much improvement might be effected both in the operation of the plant and in the service by calling in an expert to-day? We have no doubt that there are many plants throughout the country where practically the same condition obtains. The owners of the plant may be satisfied because it pays dividends. The engineer may be satisfied because he built the plant. The consumers may be satisfied because they know no better. Yet, if a competent man were brought in to overhaul the plant and put it in first-class condition, eyes would be opened on all sides.

GIVING A DOG A BAD NAME.

A few years ago it was the fashion for the daily papers, when discussing electric railway matters, to refer to this system as the deadly trolley. This designation was unjust, and possibly harmful. Electric railway currents are capable of giving severe shocks to persons who come in contact with the two sides of the circuit, but they seldom, if ever, cause death directly. By far the greater number of accidents occurring on electric railways are not due to the method of propulsion, but to the speed at which the vehicles move. This danger is common to all rapid transit systems, and it seems unfair to damn one system by constantly associating with it a derogatory adjective.

The tendency to see the sensational side of things or to take a fling at a system which, for some reason, has gained the disapproval of the reporter, still persists. On account of an accident to an elevated train a short time ago, it became necessary for the passengers to descend to the elevated structure and walk back to the station. A reporter on one of the large papers, in describing this, sought to add to his narrative by dwelling upon the perils of this short journey in such close proximity to the "deadly third rail." It is all very well to inspire a feeling of respect for electrical conductors, but it does irritate to read about the imaginary dangers, as described by this uninformed reporter. One could imagine that sparks were flying in all directions, arcs were hissing, and that the passengers owed their escape to successful dodging of artificial thunderbolts. A railway current will kill a man if he is laid across the conductors long enough. The same result might be brought about more quickly if he were careless in his movements in the neighborhood of the business end of a mule. When properly erected and protected, as railway systems are in general, there is very little danger from electric shocks. It is probable that there have been more deaths from accidents to steam locomotives since the beginning of the year than from shocks obtained from railway circuits.

TELEPHONE ENGINEERING—XV.

BY J. C. KELSEY.

THE CENTURY THREE-STRAND TWENTY-FOUR-VOLT SYSTEM.

In closing the discussion of commercial common battery telephone systems, I call attention to the only telephone system developed in the eastern part of our country prior to 1904. This was in Cleveland, Ohio, and was developed by Mr. Kidney. The system uses a bridged primary for operator's purposes, cuts off both sides of the line, has a natural busy test, and is balanced at all stages of the connection. Instead of the customary 100-ohm impedances, common to a twenty-four-volt system, but forty-ohm windings are used, which may at times add a noticeable amount of current to the subscriber's transmitter. As in cut-off relay systems, the subscriber is aware of the entrance of the operator's plug, and receives a click in the receiver. Every detail has been carefully considered, and a close inspection will find this system the equal of any other in excellence of operation.

When the subscriber removes the receiver, the relay LB is actuated, and closes contact *c*. This lights lamp LL, which is in series with a pilot relay, twenty ohms, which causes the relay PR to close contacts *f*, and light pilot lamp PL. If the line is parallel to a trolley line, or is sensitive on account of great electrical disturbance, the line will not be noisy, as is usually true of common battery systems, as the relay LR is balanced, and offers equal retardation to whatever charges that attempt to escape to ground through other lines. This system is not grounded, which is well for smaller exchanges; but when the subscriber list is large, the resistance of the system gets so low that it is the same as grounded. And a ground at the battery will protect the weaker lines from the escaping charges on the disturbed lines.

The operator, seeing LL lighted, inserts answering plug AP, which allows battery to flow through relay ASR, which controls the answering supervisory lamp, and the cut-off relay COR. The energization of COR cuts off battery connections from the line at *d* and *e*, LR becomes deenergized, and LL darkened. The pilot relay and lamp are also put out of service.

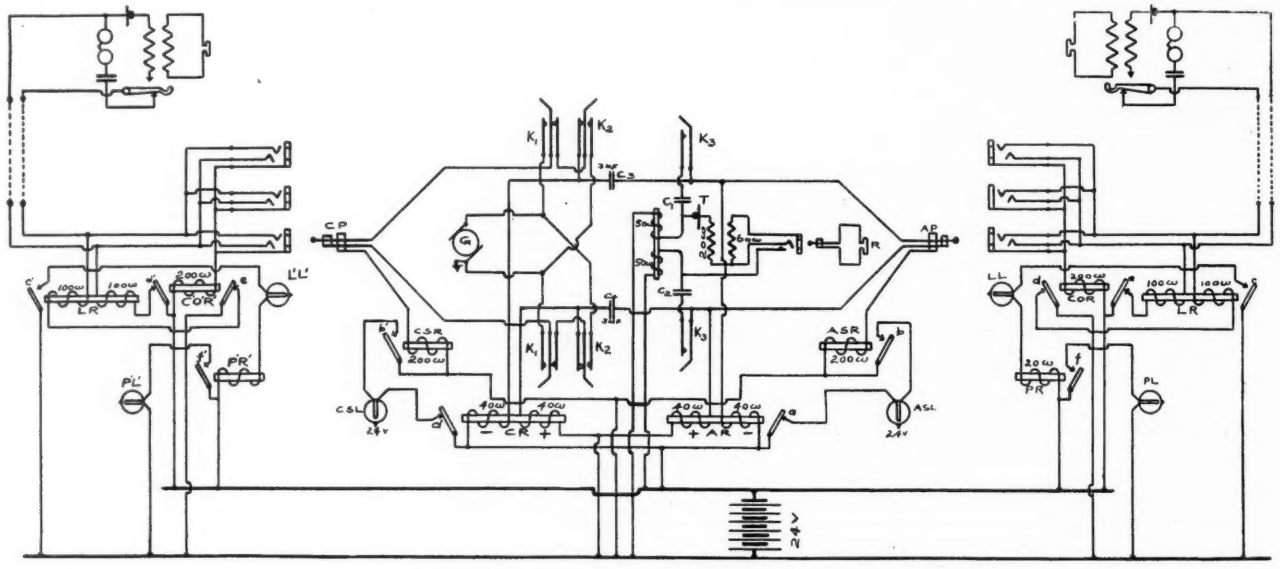


FIG. 26.—THREE-STRAND CUT-OFF RELAY SYSTEM.

When the operator plugged in, relay ASR closed contact at *b*, and ASL would have lighted, but contact *a* is open, because the relay AR is energized, it taking the place of the line relay LR.

With K_3 the operator bridges her primary winding and transmitter across the line, and ascertains the desired number. The operator's set is a very ingenious arrangement, and differs from all other systems. Battery is furnished the primary circuit through a fifty-ohm tandem winding. Two condensers, C_1 and C_2, complete the bridge without causing the least interference to the cord circuit. The receiver circuit is simply closed with secondary winding resembling the usual independent method of connecting subscriber sets.

Ascertaining the number, the operator tests by touching the tip of the plug to the desired jack-sleeve. If the line is busy, a positive potential exists on a normally negative condition. The positive current from the jack-sleeve passes back over the tip side of the circuit through the minus winding of CR, and thence to negative side of battery. Energy is stored up in the core of CR. When the tip is removed the magnetic energy quickly dies to zero value, thereby generating a current in CR which shows itself in the operator's receiver in the form of a click and also to the calling subscriber.

If the line is not busy the negative tip touched to a negative jack-sleeve will produce no click, hence the operator inserts calling plug CP. This energizes relay CSR, closing contact *b'* and lighting lamp CSL. It also energizes cut-off relay C'O'R', so that the removal of the called subscriber's receiver will not affect the line signals and give a false signal.

The operator has two keys at her disposal for ringing. If one party is to be rung—on a two-party line without disturbing the other—the bells are connected to ground on the respective sides of the line. If key K_1 was used the party whose bell was connected to the tip-side of the line would be called. If the operator used K_2 the party on the ring-side would be called. When the party answered relay CR would be energized and open contact *a'*, causing lamp CSL to be extinguished. The controlling relays or supervisory relays are AR and CR. When the parties hang up receivers these relays close contacts *a* and *a'*, lighting supervisory lamps ASL and CSL, whereupon the operator pulls down the connection.

The condensers C_3 and C_4 perform

the usual service of making complete the talking connection between the subscribers of the impedance system. In every sense this system is complete. It gives a clear ringing circuit which those systems with permanently bridged relays or impedances very clearly lack. There is no doubt that the bridged impedance or relay cuts down ringing very seriously and gives a general relay chattering. The click of the receiver is felt, which may be said to be the only fault.

The question of battery is immaterial. A ten-volt battery system would give just as good transmission as a twenty, forty, or forty-eight-volt system. The results would be better, too. With low-voltage there is less strain on insulation and less chance for leakage. The only advantage of high-voltage work is that relays can be made more cheaply.

It is the alternating-current values that count. It is alternating current that passes through condensers, repeating coils, induction coils and receivers. The alternating current produced by a transmitter on a forty-volt system is no greater than that produced by a ten-volt system. The alternating-current values of the Bell long-distance forty-eight-volt circuits are not as high as those produced by the normal twenty-four-volt system, yet they use forty-eight volts. There is as yet several and many unsettled points about communication.

One man says a transmitter with great range is the thing. He also says that alternating pressure does not count. But what else does a transmitter with great range do than to raise the pressure above that attained by a feebler transmitter. It is a well-known fact that local battery transmission is better than common battery transmission. It is also said that a common battery transmitter is superior to a local in points of construction. It is not the fault of the common battery transmitter then. It is the fault of the apparatus which projects the alternating currents out on the line. And a measurement of local battery talking alternating pressure reveals that its electromotive force is twice what the best common battery transmission can produce.

If this is the case, then it can not be that higher pressure is a detriment. One might say that the higher the pressure the greater the absorption by the capacity of the line. Yet, the higher the pressure the greater will be the current on the line and the lesser effect will absorption due to capacity have.

The currents flowing, due to local battery service, are much greater than common battery. The inference is that common battery systems have not the power of impressing energy upon the external lines that the local battery transmission possesses.

It has been done time and time again, but a common battery transmission has failed and the substitution of a local battery set in good order has succeeded. Surely, the fault is in the system. Whether repeating coil or retardation, there is no difference in the alternating pressure obtained. The same subscriber's instrument will give the same pressure out on the toll line with either system. It is alternating current in each case and the advantage is with neither. Neither one will come within half way of the alternating values of local battery.

There has been talk concerning relative advantages of two and three-strand systems. Some claim that the two-strand system is objectionable on account of bridged impedances and that its missing third sleeve-strand will not allow of special work, such as metering, etc. The bridged impedances in the two-strand systems are actually an aid in transmission and not a detriment. About the work done with the third strand, there is not one thing which can be done with a three-strand system which can not be done with the two. One thing is objectionable, a two-strand system has difficulty in ringing out on both sides of the line. However, the Kellogg four-party harmonic ring makes it unnecessary to ring out on both sides of the line.

Out of all the commercial systems there seems to be but three original systems. The Bell repeating-coil system being in the field first naturally covered a great deal of ground and made the path of the inventor along new lines a hard one. A great many names are concerned with the repeating-coil system, each contributing some distinct feature and making the system a success in every way. The names of Stone, Hayes, Scribner, Carty, McBerty and Conner have a lasting place. McBerty has contributed a great feature to the system and that lies in the present repeating coil. Without the No. 13 repeating coil the Bell telephone system would have very disagreeable work to perform, if putting all the lines on metallic basis can be called disagreeable. However, from a scientific standpoint, the No. 13 repeating coil has merit enough to stand alone. In these days of earth currents from the very numerous electric lines, the trunking of connections between exchanges would be a difficult matter were it not for Conner's contribution of the high-resistance disconnect trunk relay.

The original two-strand work has among its vital contributors Dean, Dunbar, Miller, Webster and Libby. The system that these men worked out stands without priority. It has numerous imitators and its excellence has not a doubter. This group of engineers in the Kellogg Switchboard and Supply Company gave to the independent telephone field a great share of its impetus.

Another distinctive system is that worked out by Fowler, of the Sterling Electric Company, in which he permanently bridges the relay across the circuit in series with the only or common battery. It is this system that gives the clean, quiet operation, which advantage is partially offset by the weakened ringing, due to the low impedance of the bridged coils when traversed by low-frequency ringing currents.

Switching, both by manual and automatic means, has nearly reached its maximum utility. There is a tendency now to improve the transmission and it is safe to say that a few years will find the present method of speech transmission considerably altered.

The Application of the Cymometer to the Measurement of Coefficiencies of Coupling of Oscillation Transformers.

A paper "On the Application of the Cymometer to the Measurement of Co-Efficiencies of Coupling of Oscillation Transformers," was read by Dr. J. A. Fleming at a recent meeting of the Physical Society, of London. This paper deals with the latest pattern of instrument called by the author a cymometer, designed for the measurement of the frequency of electric oscillations, and also the length of long electric waves. It consists of a sliding tubular condenser, consisting of two brass tubes, separated by a thin ebonite tube, the outer tube being capable of sliding off the inner tube. Parallel with this sliding condenser is placed an inductance coil or helix, of bare copper wire, wound on an ebonite tube. The outer brass of the sliding condenser carries a collar, which in turn carries a rod with a crutch at the end resting upon the inductance coil. The circuit of the instrument is completed by a copper bar which joins one end of the inductance coil with the inner surface of the sliding condenser. When the outer tube of the condenser is moved by an insulating handle, the same motion reduces equally the capacity of the condenser and the

portion of the inductance coil included in the closed circuit. The circuit therefore consists of a variable capacity and inductance in series. The author calls the square root of the product of the capacity and inductance in any position, the oscillation constant of the instrument. A scale is provided parallel with the inductance coil, on which is engraved the oscillation constant and the corresponding frequencies connected therewith by the formula $n = 1/2\pi\sqrt{CL}$. In addition to this, the instrument is provided with a vacuum tube, preferably a Neon vacuum, which is connected between the inner and outer surfaces of the condenser. The instrument is used in the following manner: the copper bar is placed parallel and near to a circuit in which oscillations are taking place, and the handle of the instrument is moved, thus varying the oscillation constant, until the vacuum tube glows most brightly. Under these circumstances it is known that the circuit of the cymometer is in resonance with that of the circuit being tested, and their oscillation constants are therefore the same, hence the scale reading gives the product of the capacity and inductance of the circuit being tested. The instrument is also provided with a rectangular wire circuit, the inductance of which is known. If this circuit is joined up with any unknown capacity and oscillations set up in it, the cymometer can be used as above, to determine the product of capacity and inductance in the circuit being tested, and the inductance being known, the capacity is, therefore, known also. Again, if we have any oscillation transformer, we can join up the primary and secondary circuits, so as to inductively oppose or aid one another. If we call L and N the inductance of the primary and secondary circuit respectively and M their mutual inductance, the effective inductances L_1 and L_2 of the two circuits joined in the two ways are respectively given by $L_1 = L + 2M + N$; $L_2 = L - 2M + N$. Hence we have $M = L_1 - L_2/4$ and $L + N = L_1 - L_2/2$. If, then, either L or N is separately measured, and if the resultant inductance of the compound circuit is measured, we can find the coefficient of coupling $M/\sqrt{LN}$ of the oscillation transformer. The inductance of any circuit can be ascertained for the high-frequency currents by the cymometer in the following manner: the circuit to be tested is joined up in series with a known capacity, and the rectangular circuit is provided with the instrument. Two measurements are then made: (1) when the inductance to be tested is included in the circuit, and (2) when excluded from it. If the observed oscillation constants under the two conditions are called O_1O_2, then we have the following expression for the unknown inductance: $L' = O_1^2 - O_2^2/C$. The instrument can also be used for measuring the oscillation constant or the frequency in an open oscillating circuit, such as that of a wireless telegraph aerial, and by means of it the wave-length which is being sent out from the aerial can be measured, and also the wave-length of waves being received on any aerial. The instrument can also be employed to analyze a compound oscillation taking place in a circuit and determine the component frequencies. It thus acts as an electrical equivalent of a spectroscope.

Direct-Reading Resistance Thermometers.

At the meeting of the Physical Society, of London, held March 10, Dr. R. T. Glazebrook, past-president, in the chair, a paper "On Direct-Reading Resistance Thermometers, with a Note on Composite Thermocouples," was read by Mr. A. Campbell. The paper describes two methods by which the reading of a resistance box in connection with a platinum resistance thermometer gives directly the actual temperature without the use of any formula or table. In the first method the variable resistance in the measuring arm of the Wheatstone bridge is shunted by a suitable resistance. When this shunt has the proper value, the change of resistance in the measuring arm necessary to give a balance is proportional to the change of temperature of the platinum to a good degree of accuracy up to 1,000 degrees centigrade. A more exact method (that of the "rectifying loop") is somewhat similar. In it the measuring arm consists of a closed loop of resistance, one end of the arm being a fixed point on the loop, while the other end is a slide which can be moved along the loop. The total resistance of the arm is connected by a simple parabolic law with the excess X of the slider reading over a zero reading. Thus $R = A + BX + CX^2$. The author shows how the resistance of the loop and the zero reading may be calculated so as to make this parabolic formula identical with that giving the temperature resistance variation of any specimen of platinum. When the resistances have these values, the reading X will be proportional to the temperature (centigrade) of the platinum.

In an appendix the author points out that for measuring small temperature difference up to 100 degrees or 150 degrees, the most useful thermocouples are iron-nickel or iron-constantan. The voltages given by these are nearly, but not quite, proportional to the differences of temperature. In order to make the proportionality more exact, he proposes to use a "composite" (triple) junction by putting in parallel with one of the usual wires a wire of a third metal (*e. g.*, copper); by adjusting the relative resistance of the branches of this parallel circuit, the temperature voltage curve of the combination can be practically rectified.

Mr. W. Duddell said that by putting a constant resistance in series with the rectifying loop, it would be possible to simplify the mathematical processes involved in the method.

Professor Callendar thought the rectifying loop method of reducing the direct readings to the gas scale would be useful in practical work, especially at high temperatures, but for the most accurate scientific work at moderate temperatures the corrections would be too complicated, and trouble would be saved by adopting the ordinary method. It was most important in practice to secure accurate compensation of the leads which could be ensured in a satisfactory manner only by making the leads and the ratio arms equal. Neither the loop method, nor the three-lead arrangement subsequently proposed by the author, could be used with a bridge-wire, as both involved plug or sliding contacts of negligible resistance. The three-lead arrangement also precluded the possibility of making an insulation test of the leads at any time. With regard to composite thermocouples, he did not think the arrangement would be useful except for very moderate ranges of temperature.

The chairman pointed out that for the most accurate work it was advisable to work with the simplest possible form of apparatus and to apply the necessary corrections at the end. The constantan wires referred to by Mr. Campbell had been tested over a large range of temperature, and it had been found that a constantan-iron couple gave a linear formula.

Mr. Campbell, in reply, said it would be possible to arrange the rectifving loop with plug contacts instead of sliders; with twenty-five ohms in the measuring arm, sliders could not cause serious error. He had indicated clearly in the paper that when once the ratio of the resistances of the zero reading and the total loop (or the shunt) was found the absolute values of these resistances might be altered in any ratio desired. The bridge could thus have equal or unequal arms at will.

Electricity in the Anthracite Coal Mines—II.

The Application of Modern Methods in the Development of a Long-Established Industry.

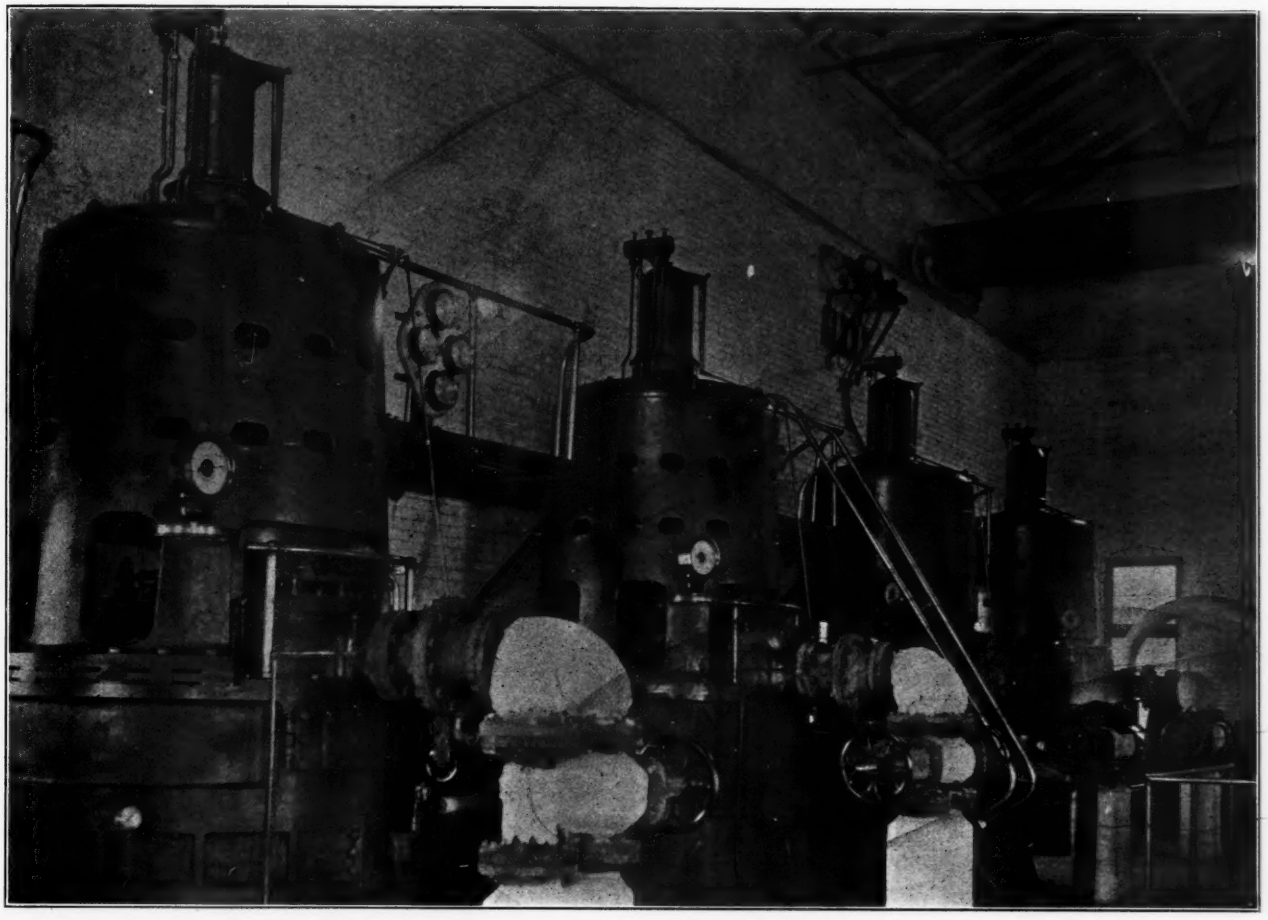
By Robert Thurston Kent.

THE Hampton central power station, which has been erected about two years, generates current for transmission to eight different collieries in the vicinity of Scranton. These are the Bellevue and Dodge, the Brisbin, the Cayuga, the Hyde Park, the Pyne, the Sloan, the Diamond and the Archbald. Of these, the line to the Cayuga colliery is not yet in operation. The voltage on this line is to be higher than on the others, and the transformers to raise the voltage are not yet installed.

The station is located near the Sloan colliery, and consists of two buildings—boiler house and turbine station. The turbine station is built of brick, with a peaked slate roof, and has one main floor and a basement. On the main floor are installed the generating sets, the exciters and the switchboard. In the basement are placed the air pumps for the condensers, the oil pumps for maintaining pressure beneath the step bearings of the turbines and an oil switch for a heavy-current line. The transformers for the Cayuga line will eventually be placed in the basement also.

The generating units are four 500-horse-power Curtis turbines, each direct-connected to an alternating-current generator. The turbines run at 1,800 revolutions per minute with steam at a pressure of 150 pounds per square inch, superheated 200 degrees Fahrenheit. The generators are three-phase, sixty-cycle, 126-ampere machines generating current at 2,300 volts. This is the voltage used on all the transmission lines except the Cayuga, no transformers being interposed between the generator and the line. These machines are placed in a row along one wall of the building.

The field current is supplied by two fifty-kilowatt, 125-volt direct-current generators which are each direct-connected to a McEwen engine running at 280 revolutions per minute. The exciters are placed at one end of the building, one on each side. They run with saturated steam at 150 pounds per square inch pressure. Each exciter furnishes field current for two alternators.



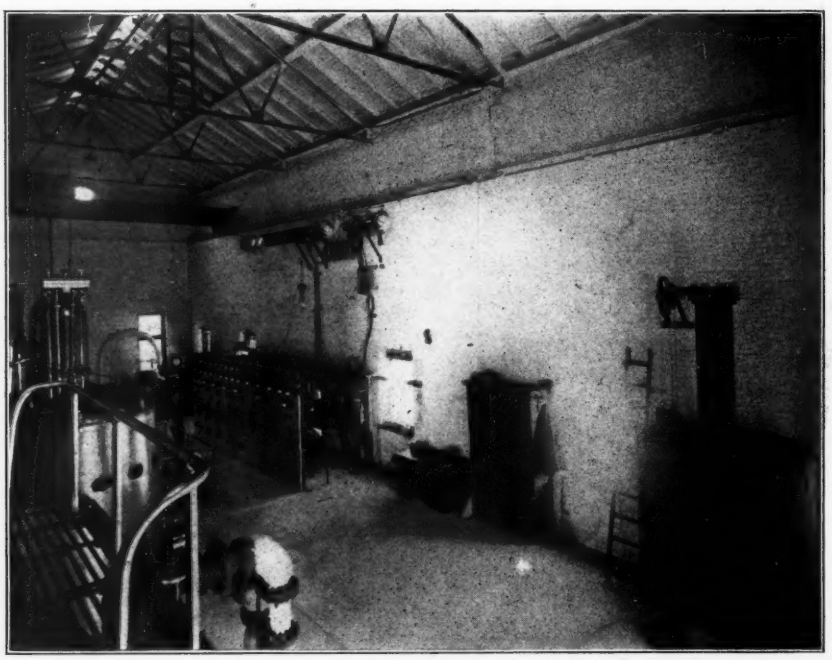
CURTIS TURBINES IN HAMPTON CENTRAL POWER STATION, DELAWARE, LACKAWANNA & WESTERN RAILROAD.

Outside the building and directly behind the turbines are four Worthington barometric condensers, one connected to each turbine. The turbines exhaust to these through a tee. The exhaust steam enters at the side, and the condensing water at the top of the tee. The condensed steam and the water fall through the condenser tube to the basement, where they are removed by an air pump. There are two of these air pumps, each taking care of two condensers. The pumps are

Worthington make, and the cylinders are ten by eighteen by eighteen inches. A vacuum of about twenty-eight inches is maintained.

The condensing water is at present supplied by a steam pump which lifts the water from a stream a few hundred feet distant and pumps it to the station. This arrangement, however, is only temporary, and will be replaced by a gravity supply when the water hoist now building is completed. This water hoist will be described later.

Each turbine is supplied with a gray marble gauge board, on which are mounted four gauges. These gauges show, respectively, steam pressure, first stage of vacuum, full vacuum and the pressure underneath the step bearing. The boards are mounted beside each turbine on the railing of a gallery which runs along the top of the machines.



INTERIOR OF HAMPTON CENTRAL POWER STATION, DELAWARE, LACKAWANNA & WESTERN RAILROAD.

Steam is brought into the building from the boiler house by two lines. One of these lines takes saturated steam from the steam drums of the boilers. The other receives it from the superheaters. Branches run from each of the two lines to each of the turbines, being united at the nozzle. Stop valves are placed in each branch, so that they may be cut out in case of accident, and the turbine run on saturated or superheated steam, as the case may be.

The steam lines enter the station through the basement, and were originally supported on brick piers. Owing to the settling of these piers and to vibrations in the lines, there was danger of the pipes being ruptured. The piers were accordingly cut down, and heavy helical springs carrying a chair were placed between the top of the pier and the pipe, the pipe being supported in the chair. This method of support has proved eminently satisfactory, and no trouble whatever has been encountered with the lines or supports.

A pressure of 300 pounds per square inch is maintained underneath the step bearing by means of an oil accumulator and two oil pumps. The pumps are Worthington duplex outside-packed plunger pumps, with cylinders six by two by six inches. The accumulator is a plunger working within a cylinder. The plunger extends from the basement through the floor to the turbine room, and on its upper end is a large cylindrical weight. Whenever the oil pressure falls, the weight and plunger descend, tending to raise the pressure. The throttle valves of the pumps are connected to the accumulator and plunger by means of chains with weights on the ends. The chains are wrapped around pulleys on the valve stem, and open the valves whenever the plunger descends, thus starting the pumps and raising the pressure. As the pressure is restored, the plunger rises, closing the throttle valves, and either slowing down or stopping the pumps. Should the pumps become disabled, the accumulator will keep the pressure at 300 pounds per square inch for five minutes with all four turbines in operation, and for twenty minutes if only one turbine is running.

The steam-driven oil pumps have replaced pumps which were driven by electric motors. These were installed when the station was first put in operation. The motors were of the direct-current type, and current was furnished for them by the exciter units. The exciter engines, being run with saturated steam, would slow down whenever the steam pressure dropped, and the voltage was thus lowered. The pump motors would slow down, and the oil pressure would fall, so that the turbines suffered in consequence. Since the installation of the steam-driven pumps no trouble from this cause has been experienced.

The oil coming from the turbines is run first through a filter to remove impurities, and then through a separator, which frees it from water. The filter and separator were built by the Hendricks Manufacturing Company, of Carbondale, Pa.

The switchboard is installed on the opposite side of the station from the turbines, and faces them. It consists of seven panels of gray marble. One panel is for the exciter units, and carries an 800-ampere Thomson astatic ammeter for each machine and one 175-volt Thomson astatic voltmeter. A plug switch allows throwing the voltmeter on either unit. There are also placed on the panel two three-pole, single-throw switches for connecting the exciters to the alternators' field bus-bars, and three single-throw, double-pole switches for the station lights, which are run from the exciters. The rheostats for the exciters are placed on the back of the panel, and their hand wheels project through to the front.

There are four alternating-current generator panels, one for each machine. Each panel carries two 600-watt Thomson indicating wattmeters and two Thomson astatic ammeters registering, respectively, to 100 and 250 amperes. There are also on each panel a 175-volt Thomson voltmeter, which is used with a multiplier of twenty, and a single-throw, double-pole switch for the field current. An oil switch is mounted on the back of the panel for the generator current, and a relay on the front of the panel will throw the switch in case of a short-circuit or heavy overload. The field rheostats for the alternators are located in the basement. They are worked by means of a hand wheel on the panel, which is joined to the rheostat by a chain and sprocket wheels.

Three output panels take care of the

current going to the substations. These panels each carry a 250-ampere Thomson ammeter and an oil switch on the back. There is also a relay on each panel for throwing the switches in case of overload.

There is also one panel for the current going to the water hoist heretofore mentioned. As about 1,500 kilowatts at eighty-five per cent power-factor and 2,300 volts are to be transmitted, the current will be very heavy, and it was considered best to place the oil switch in the basement, and break each line in a separate compartment. Accordingly, an electrically operated switch was placed in the basement, with each line in separate compartments, with a slate floor and a four-inch brick wall between. The switch is thrown from the switchboard. The leads are encased in lead cables, and run up the sides of the building to the roof, where they are taken out.

In addition to the other instruments, each output panel carries an integrating wattmeter on the back. A synchronizer and ground detector complete the switchboard equipment. The transformers for the various measuring and indicating instruments are placed on the wall directly behind the various panels on which the instruments are carried.

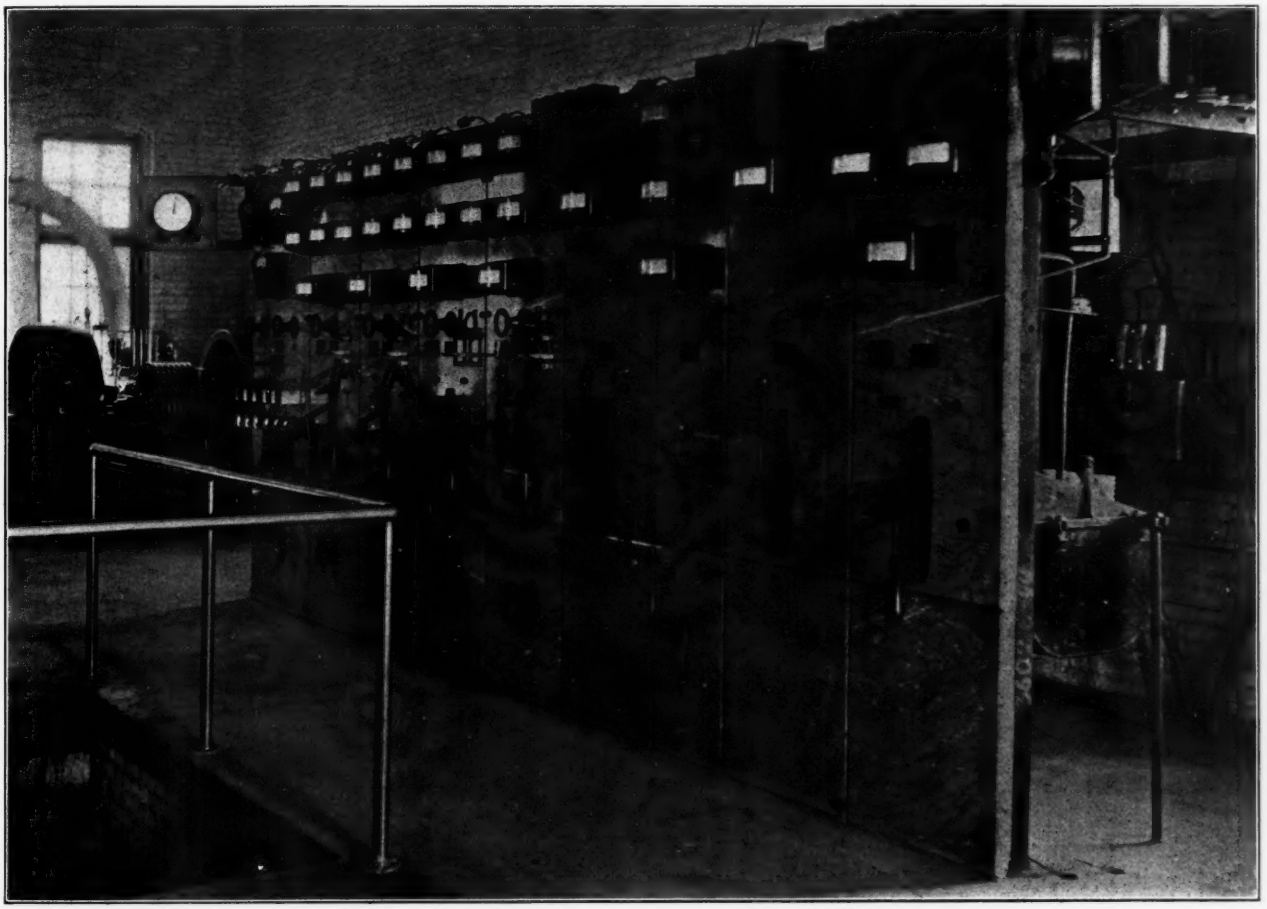
A twelve-ton traveling hand crane completes the station equipment.

The leads are taken from the building through sewer pipes set in the wall directly under the eaves, and pointing downward to the outside at an angle of about thirty degrees. In the bell end of the pipe a heavy circular glass plate is inserted, and the wire is carried through a hole in the centre of this plate. Considerable trouble, however, has been experienced by the glass plate working loose, and falling out, and it is probable that the method used at the Bellevue substation will hereafter be adopted.

The boiler house is located about twenty-five feet distant from the turbine station, and is a brick and frame building. The boiler equipment consists of fifteen 300-horse-power Babcock & Wilcox boilers operating at 125 pounds pressure. The boilers are fitted with McClave stokers, which are driven by a slide-valve engine which is geared to a countershaft running the length of the building. The stoker shafts are connected to the countershaft by means of chain belting.

Feed water is passed to the boilers by two Epping-Carpenter compound duplex feed pumps with steam cylinders ten and twenty inches diameter by eighteen inches stroke, and with water cylinders ten by eighteen inches. Before entering the boiler the water passes through a Green economizer. Each boiler is fitted with a Babcock & Wilcox superheater which will superheat the steam 200 to 235 degrees Fahrenheit. Steam is taken from the drum of each boiler through an eight-inch nozzle to a header which runs the length of the boilers. This header branches into a number of lines, one line going to the turbine station, and the others to various collieries in the vicinity. Some of these lines are nearly 2,000 feet long. Another line from the superheaters carries steam to the turbines only.

A combination system of forced and induced draught is used. Two sets of fans, driven by steam engines, are installed, one delivering air into the ash-pit of the boilers, and the other into the stack just beyond the economizer. The pressure of the air delivered into the ash-

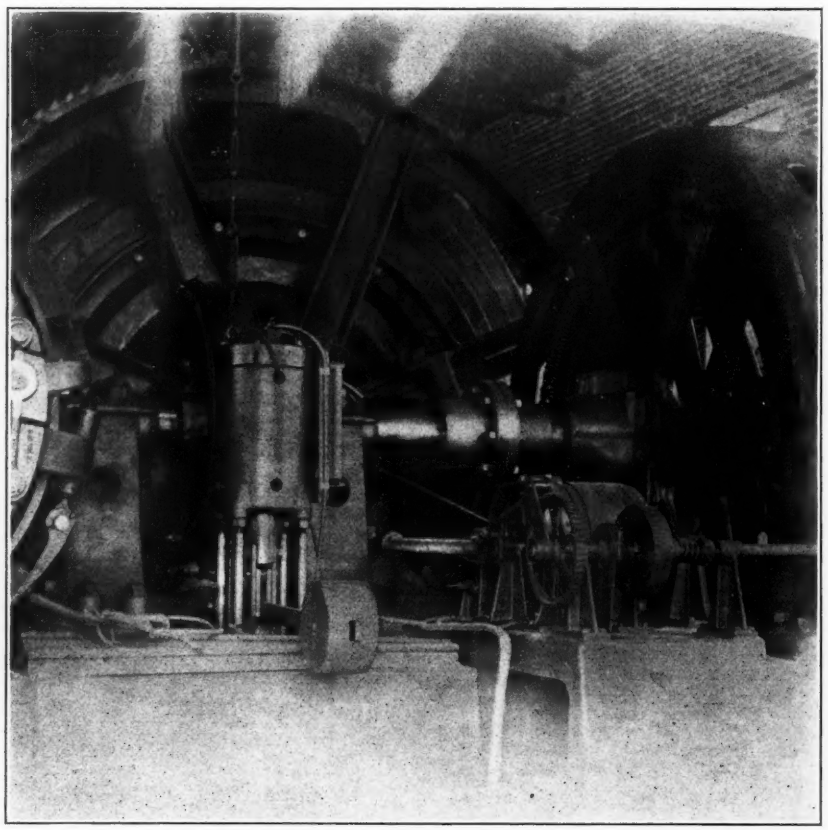


SWITCHBOARD AT HAMPTON CENTRAL POWER STATION, DELAWARE, LACKAWANNA & WESTERN RAILROAD.

pit furnishes just sufficient draught to force the air through the fire, and to carry the gases of combustion through the economizer, and any regulating of the draught is generally done by means of the fans delivering air into the stack.

Coal is brought to the boiler house in railroad cars which are run on a trestle in the boiler room. The coal is dumped into an overhead storage bin below the trestle, and is spouted from this bin directly to the stoker hoppers.

The ashes are removed by flushing them from the ash-pits with water, and the mixture is forced through a bore hole into the mine. The ashes are then used for filling up the abandoned workings.



MOTOR AND WINDING DRUMS FOR WATER HOIST. HAMPTON CENTRAL POWER STATION, DELAWARE, LACKAWANNA & WESTERN RAILROAD.

The water hoist heretofore mentioned is located about 500 feet from the power station. A shaft about 460 feet deep has been driven and all the mines in the vicinity will drain to it. Water will be hoisted from this shaft by means of two buckets suspended from a hoist tower over the shaft. Around the base of the tower has been built a concrete basin, into which the buckets will be dumped. The water will be piped from this basin to the boiler and turbine station, where such of it as is needed for condensing and other purposes will be utilized. The remainder will be carried on down the hill, and discharged into the Lackawanna river.

The hoist tower is ninety-three feet from the base to the centre of the sheave at the top. It is built of structural steel, roughly in the shape of an A. From the tower are suspended two buckets six feet in diameter and nineteen feet six inches deep. The capacity of each bucket is seventeen tons of water. In the bottom of the bucket are located two lift gates with an area practically equal to the cross-section of the bucket. These gates are lifted automatically when the bucket reaches the top, and the water is discharged through the bottom into a spout fitted below the bucket, and which deflects it to either side of the shaft. Each bucket makes a complete round-trip in one minute and fifty-five seconds, the total lift being 555 feet.

The buckets are raised and lowered by means of an 800-horse-power induction motor running at a constant speed of 400 revolutions per minute, driving a pair of drums on which the cables from the buckets are wound. These drums are conical, in order to obtain a slow starting speed. The two diameters of the drum are sixteen feet and ten feet. The motor is set at right angles to the drums, and motion is transmitted to the latter through a friction clutch and bevel gearing. Band brakes are placed at a number of different points, in order to make a quick stop if necessary.

The substation located at Bellevue colliery is not typical of those installed at the other collieries, in that it has an engine and generator. A typical substation is that at the Sloan mine, a short distance from the Hampton station. This station is built of brick, one story high, and is about fifteen feet square. It immediately adjoins the engine house containing the engines used for operating the cages in the mine shaft.

The equipment of the station consists of a 200-kilowatt rotary converter running at 900 revolutions per minute, by means of which alternating current at sixty cycles and 104 volts is converted to direct current at 275 volts. The current is stepped down to 104 volts from 2,200-line voltage by means of three seventy-five-kilowatt, type H, oil-cooled transformers built by the General Electric Company.

The switchboard in the substation has two panels, one for the alternating-current end, the other for the direct-current end of the rotary. The alternating-current panel carries three blow-out fuses, a power-factor indicator, a Thomson ammeter and an oil switch. The direct-current panel carries an overload circuit-breaker, a 1,500-ampere ammeter, a rheostat, a single-pole, single-throw switch, and a 600-volt voltmeter. The wires are carried into the station in the same manner as they are led out of the central power station.

All rotary converters of 300 kilowatts capacity and over are used with six-phase current. This is done in order to obtain a smaller unit for the same horse-power, and the phase is changed from three to six in all cases by means of transformers.

The Nanticoke Power Plant—The new Nanticoke power station is located between Nanticoke and Wilkesbarre, and is about three miles distant from the latter place. It is on the bank of the Susquehanna river, on the Wilkesbarre side. This station will represent the latest and best practice in the application of electric power to coal mining. It will also be the first use of induction motors in the mine and breaker. Power will be transmitted to four collieries, which are from two to four miles distant.

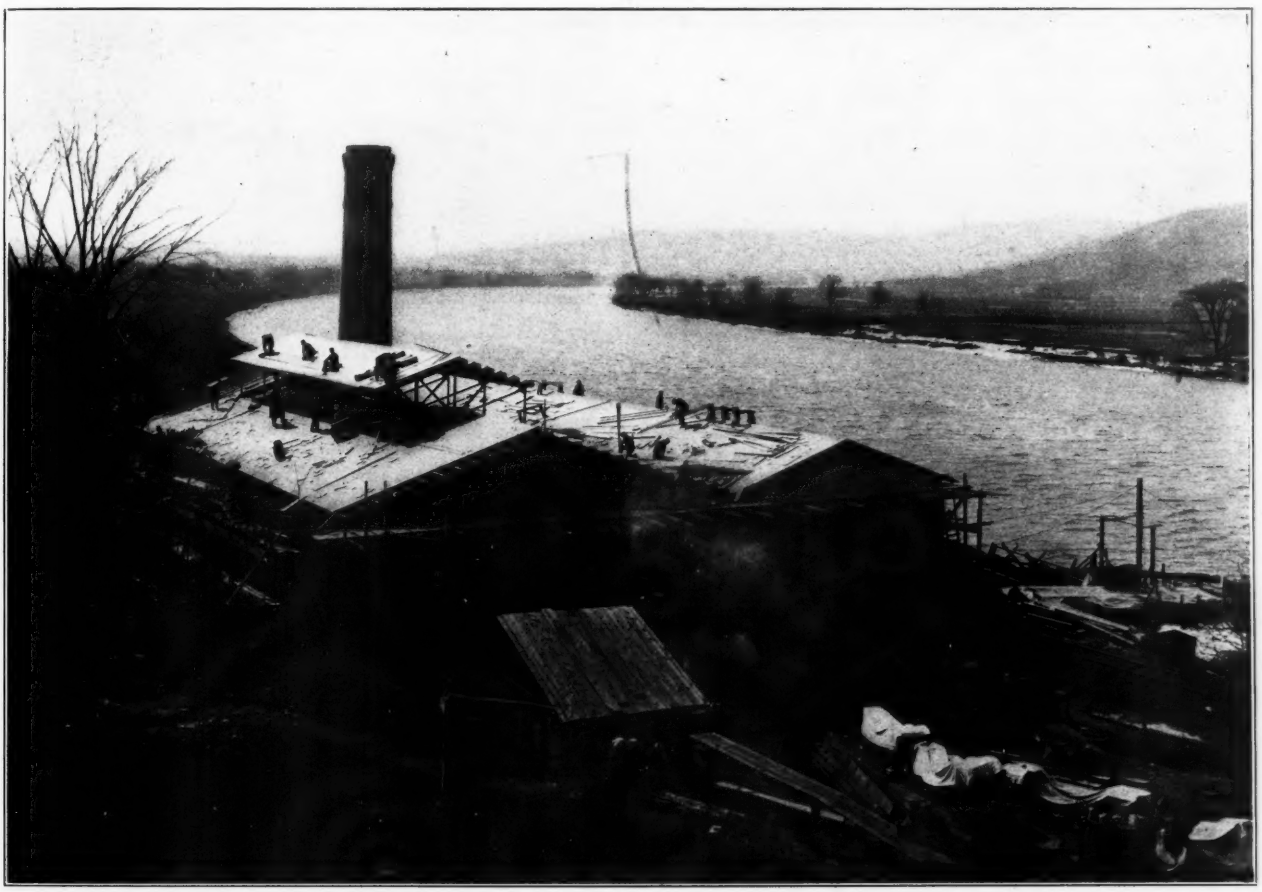
The power station consists of two buildings immediately adjoining one another. One of these is the boiler plant, and the other the tur-

bine house. The floor of the boiler house is about five feet above that of the turbine station, while that of the turbine station is about twenty-two feet above low water in the river. The turbine station is located on the side nearest the river. The present equipment will be three 500-kilowatt Curtis turbines, which will operate with steam under a pressure of 150 pounds per square inch and a superheat of 200 degrees. Each turbine is to be direct-connected to a revolving-field, three-phase, sixty-cycle, 4,150-volt alternator, connected on the four-wire system. to the various collieries without transformers at a voltage of 4,150.

The boiler equipment consists of three 303-horse-power Babcock & Wilcox boilers, each boiler fitted with a Babcock & Wilcox superheater. The boilers are to be hand-fired and will have Parsons stationary pin-hole grate bars. The furnaces are designed to burn refuse from the mine of a size not larger than barley.

The station has a Custodis brick stack seven feet in diameter by seven feet high. This will not be depended upon room. It will be brought in to the boiler room by a scraper conveyer, which makes a right-angled turn near the track and delivers the coal on the boiler-room floor.

The ashes are to be removed by means of a small crane. This crane runs on an I-beam suspended along the front of the boilers. It is equipped with a small Sprague direct-current motor, which causes it to travel along the I-beam in the boiler room and along a track built outside, and which is carried to any point at which it may be desired to dump the ashes. Another small motor is used for



NANTICOKE POWER STATION UNDER CONSTRUCTION, DELAWARE, LACKAWANNA & WESTERN RAILROAD.

Although but three of the turbines are to be installed at present, the station has been designed for an ultimate equipment of five.

The auxiliary apparatus installed in the turbine station will consist of a steam pump for oil circulation for the step bearings of the turbines, and two exciter units. The exciters are seventy-five-kilowatt, 125-volt, direct-current machines. One exciter is to be driven by a seventy-five-kilowatt Curtis turbine, and the other by a seventy-five-kilowatt, 440-volt induction motor. Current will be transmitted for draught however, the draught being furnished on the Parsons system. The station has been designed to allow five boilers to be eventually installed.

Feed water will be furnished by two Knowles duplex horizontal pumps, each one of which is large enough to supply all the boilers. Water is passed through a Cochrane feed-water heater before entering the boilers.

Coal will be brought to the station from the mines by a branch of the Lackawanna Railroad, and dumped at the back some 200 feet away from the boiler raising and lowering the bucket in which the ashes are carried. When it is desired to remove ashes the bucket is lowered to the floor and placed immediately under the fire-doors. The ashes are then drawn into the bucket from the furnace with a hoe, and the bucket is then raised by means of the motor. By throwing a switch the travel motor carries the bucket outside, where it is automatically dumped by a trip. As soon as the ashes are emptied from the bucket the travel motor is automatically reversed, and the carriage is returned to

a point just outside the boiler room, where it stops.

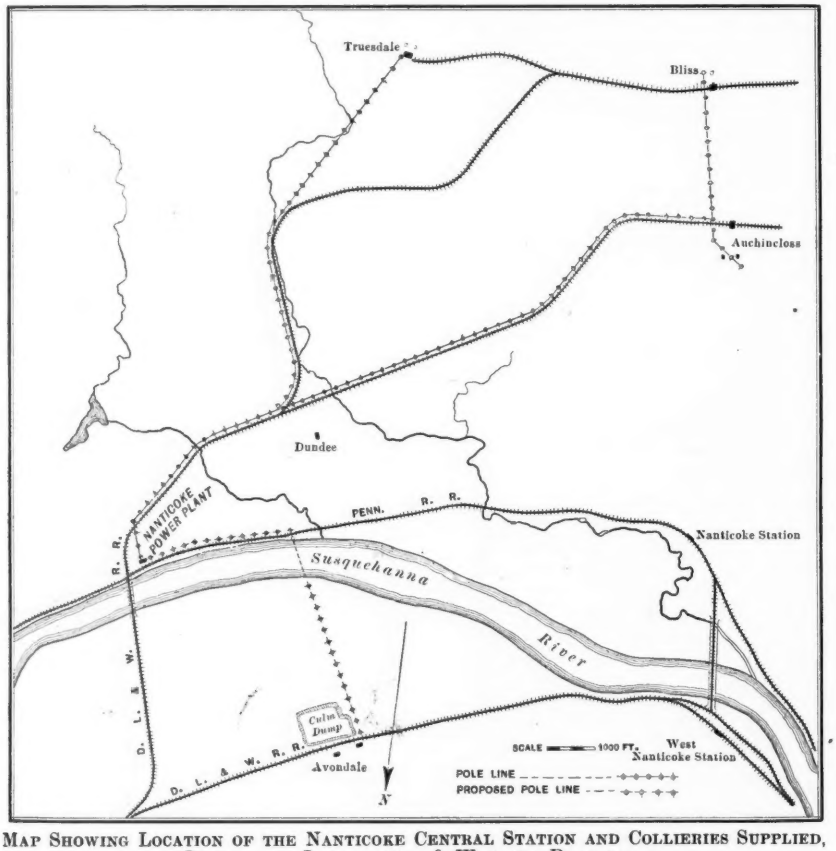
The condensers are to be Worthington surface condensers, one for each turbine. The condensed water is pumped by motor-driven centrifugal pumps into the heater, and thence into the boiler.

The condensing water will be obtained from the river by means of a tunnel which is driven from the river about ten feet below low water mark to a shaft in the station. There is a partition in this tunnel, the cold water going on one side, and the hot water on the other. At the river end of the tunnel walls are built to deflect the hot water away from the entering water, so as not to raise the temperature of the latter. The water will be elevated to the condensers by three vertical-shaft Worthington centrifugal pumps. The pumps are to be driven, respectively, by thirty, sixty and ninety-horse-power General Electric induction motors. Eventually the full output of the pumps will be 10,000 gallons per minute. In addition to condensing water, make-up water for the boilers will be taken from the tunnel.

In the vertical shaft driven down to the tunnel there is a vertical steam pump built by the Scranton Steam Pump Company, which is to be used for feeding the boilers whenever the condensers are stopped.

The power generated at this station is to be transmitted to the following collieries: the Auchincloss, the Bliss, the Truesdale and the Avondale. At the Auchincloss colliery the shaft is seventeen hundred feet deep. The high-tension wires will run directly down the main shaft to the motors. In this mine the veins are at an angle of about forty-five degrees, and the loaded cars will be hauled up this incline by means of hoists, driven by induction motors. The hoists are close together in this mine, and one bank of transformers will be used for all the motors. There will be three 200-kilowatt transformers, stepping down the line voltage to 240 volts for the motors. In addition to the hoists, induction motors will also be used in the mine to drive a drainage pump. This will be a two-stage centrifugal pump with a capacity of 700 gallons per minute, against a 190-foot lift. It will be driven by a fifty-horse-power, 440-volt induction motor.

In the breaker there will be installed a fifty-horse-power, 500-volt, direct-current motor operating a car hoist, and thirteen other motors operating at 275 volts, and used for various purposes. Current is supplied to these by a rotary converter, and three 110-kilowatt transformers.



MAP SHOWING LOCATION OF THE NANTICOKE CENTRAL STATION AND COLLIERIES SUPPLIED, DELAWARE, LACKAWANNA & WESTERN RAILROAD.

The Bliss colliery will have installed a 300-kilowatt rotary converter furnishing direct current on the two-wire system of 550 volts. This converter is to be used in connection with two direct-current generators which are already installed. This direct current will be used to operate two hoists in the mine, as well as six locomotives at present installed and some additional ones which are to be purchased.

Inside the mine there will be a hoist driven by a 200-horse-power General Electric induction motor operating at 440 volts. There will also be a 1,000-gallon centrifugal pump operating against a head of 100 feet. This pump will be driven by a forty-horse-power induction motor, and will be used to pump a mixture of water and culm to the culm bank. The voltage will be stepped down for this motor by means of three fifteen-kilowatt transformers installed in the mine.

The breaker at the Truesdale colliery is new. There will be a substation there containing a 200-kilowatt rotary converter furnishing direct current at 275 volts. The line current will be stepped down by means of three seventy-five-kilowatt oil-cooled transformers. There will also be three 250-kilowatt transformers, stepping down to 440 volts for operating the induction motors in the breaker. When the breaker is fully equipped there will be over fifty induction motors installed. Inside the mine there will be a six-stage, 700-gallon centrifugal drainage pump working against a head of 600 feet. This pump will be driven by a 150-horse-power induction motor. Three fifty-kilowatt transformers will be installed in the mine for this motor.

At the Avondale colliery a substation is proposed. At this colliery there is at present a 200-kilowatt, 275-volt generator. The substation will contain a 300-kilowatt, 550-volt rotary converter running on the three-wire system. There is to be installed a 500-volt, 100-horse-power motor, driving a vertical-shaft centrifugal pump with a capacity of 2,500 gallons per minute against a ninety-foot lift.

The transmission lines will be carried from the power plant to the various collieries on pole-lines following the routes shown on the accompanying map. The lines to the Truesdale, Bliss and Auchincloss collieries will be ordinary pole-lines. That to the Avondale colliery will be a pole-line up to the point where it crosses the river. From the river to the colliery the line will be carried on three or four tall steel towers.

At the Bliss colliery the generators are installed on the three-wire system, the

outside wire being grounded. The three-wire system is made necessary by the fact that the motors in the mine are operated at one voltage, and the locomotives at another.

The unusual feature in the collieries operated from the Nanticoke station is the use of induction motors in the mine. The use of these was decided upon on account of the economy of copper. The shafts in some cases are 1,700 feet deep, and the motors are often located 3,000 to 4,000 feet away from the base of the shaft. By carrying the high-tension lines down the shaft and into the mine, and installing transformers at the motor, the wires are much smaller than would be the case if the alternating current was converted on the surface and direct current carried to the motors in the mine. Another feature of the use of the induction motor in the mine is the absence of sparking. This will permit its use in a gaseous portion of the mine where the use of a direct-current motor with a sparking commutator might be dangerous. This is a minor feature, however, as the engineers of the company state that the high-tension wires might easily be broken by the falling of the roof of the mine, thus causing a spark which would ignite any gases present.

It will be noted that the voltage at which current is transmitted from the Nanticoke station is about twice that at which it is transmitted from the Hampton station. All the transformers have been so wound that, at any time, they can be used at the higher voltage, so that eventually current can be obtained from either station, or the equipment made uniform in the generating stations if desired.

The extent to which the Delaware, Lackawanna & Western Railroad Company has adopted electricity in its collieries is shown by the following summary of electrical machinery installed: at eighteen stations and collieries there are installed a total of twenty-two generators, with a combined capacity of 4,498 kilowatts. There are five rotary converters with a combined capacity of 850 kilowatts. The company operates or has ordered fifty-six electric locomotives of various horse-power, the total horse-power being 3,950. In the different mines there are installed twenty-one electrically operated hoists, operated by twenty-eight motors with a total capacity of 1,915 horse-power. There are twenty-three motor-driven pumps, the motors having a capacity of 1,571 horse-power. In addition to this machinery there are installed twenty-four other motors for miscellaneous uses, having a total capacity of 318 horse-power.

The use of electricity in this industry has proved so successful that its further extension will probably be rapid. This is shown by the improvements which the Lackawanna company is making, and also by the installation of electricity in the mines of companies which heretofore have used other motive power, such as compressed air, steam, or animal power.

Seventh General Meeting of the American Electrochemical Society.

The seventh general meeting of the American Electrochemical Society will be held at Boston and Cambridge, Mass., Tuesday, Wednesday and Thursday, April 25, 26 and 27, 1905. The programme announced is as follows:

Tuesday, 9.30 A. M., session of the society in Room 6, Lowell Building, Massachusetts Institute of Technology; 1 P. M., reception by President Pritchett at the Technology Club, followed by lunch tendered by the Institute of Technology; 2 P. M., excursion to the General Electric Company's plant at Lynn; 8 P. M., presidential address at the Lowell Building, followed by a smoker at the Hotel Lenox.

Wednesday, 9.30 A. M., session of the society at Harvard University, Pierce Hall; 1 P. M., reception, followed by lunch tendered by Harvard University; 2 P. M., a visit to Harvard buildings or excursion to the New England Gas and Coke Company, at Everett; 7.30 P. M., banquet for members and ladies at Hotel Lenox.

Thursday, 9.30 A. M., session of the society at the Lowell Building; 1 P. M., lunch at the Technology Club; 2 P. M., afternoon session of the society at the Lowell Building, or inspection of the Institute Technology buildings.

The following titles of papers are announced:

"On the Heat of Solution of Aluminum Bromide in Ethyl Bromide," Professor H. E. Patten.

"The Interdependence of Atomic Weights and Electrochemical Equivalents," Professor A. Reuterdahl.

"An Optical Method of Observing a Diffusion in an Electrolyte," C. Hambuechen.

"The Microstructure of Silicon and Silicon Alloys," A. B. Albro.

"Specific Inductive Capacities," Dr. L. Kahlenberg.

"The Rotating Diaphragm," Dr. W. D. Bancroft.

"Notes on Economic Temperatures of Copper Refining Solutions," Professor C. F. Burgess.

"Electrolytic Precipitation of Chromium," Professor H. R. Carveth.

"Conduction in Electrolytes," Dr. J. W. Richards.

"Adherence of Nickel to Nickel," R. C. Snowdon.

"Electrodeposition of Silver," R. C. Snowdon.

"Treating Low Grade Ore and Tailings by Electrolysis," Ernest Fahrig.

"Some Experiments with the Reduction of Titaniferous Ores into Steel and Titanate of Iron," A. Lodyguine.

"Experiments with the Reduction of Different Oxides of Lead by Electric Current," A. Lodyguine.

"Some Results of Experiments with the Electrodeposition of Metals on Aluminum," A. Lodyguine.

"Billitzer's Method of Determining Absolute Potentials," Dr. H. M. Goodwin.

"On the Utilization of Blast Furnace Gases in Connection with Electric Smelting," A. J. Rossi.

"A Low Voltage Standard Cell," Professor G. A. Hulett.

"A Diaphragm Cell for Electrolysis of Brine," C. P. Townsend.

"Colloids," Dr. W. R. Whitney.

"Electric Arcs," Dr. W. R. Whitney.

"Mercury Arc," Dr. E. Winetraub.

"Reversible and Irreversible Polarization," Professor W. S. Franklin.

"An Electric Switch," William Smith Horry.

"Electrostatic Method for Separating and Concentrating Ores," Professor Lucien Ira Blake.

"The Aluminum Electrolytic Condenser," C. J. Zimmerman.

"Metallic Thorium," Professor Charles Baskerville and Fritz Zerban.

The headquarters will be at the Hotel Lenox, Boylston and Exeter streets, Boston.

The Manufacture of Concrete Blocks and Their Use in Building Construction.

The Engineering News Publishing Company, 220 Broadway, New York city, announces the offer of $350 in prizes for the best papers on "The Manufacture of Concrete Blocks and Their Use in Building Construction." The author whose paper is judged to be the best will receive a prize of $250. The author whose paper is second in rank will receive a prize of $100. From the whole number of manuscripts offered, the five best will be selected for submission to a jury consisting of Messrs. Robert W. Leslie, past-president of the American Cement Manufacturers' Association; Richard L. Humphrey, president of the Cement Users' Association, and Professor Edgar L. Marburg, secretary of the American Society of Testing Materials.

A FIELD FOR THE ILLUMINATING ENGINEER.

BY L. B. MARKS.

Although much progress has been made in recent years in the development of various types of electric lamps, the art of electric lighting in so far as this art applies to the proper amount and distribution of light for the illumination of interiors has not kept pace with the development of the lamps themselves.

The electrical engineer may be skilled in designing electric light plants, but when it comes to laying out the detailed lighting scheme of a house, he is apt to fall short for the reason that his training does not, as a rule, qualify him to obtain the best results in this particular field. As a matter of fact it is often the architect, rather than the electrical engineer, who decides the lighting problem and prescribes the location of outlets for lamps. Sometimes the decorator may be called upon to arrange the lighting scheme, and even the fixture manufacturer often has a hand in the matter. Lastly, the owner himself may suggest certain arrangements which though ridiculously extravagant are carried out because no one in particular has direct charge of the whole question of illumination.

This condition of affairs accounts for the glaring defects in lighting which are noticeable in most residences at the present time. In some cases the outlets for the lamps are improperly placed; in others where the outlets are correctly located, the number of lamps on the individual outlets is either too large or too small. In still others, where both of the above conditions are properly complied with, the intrinsic illumination of the lamps themselves may be entirely too great. This last defect is the most common of all. Unshaded or inadequately shaded lamps, hung low in the rooms, are the rule rather than the exception. Lights so hung are exceedingly trying on the eyes and are directly responsible for many a case of nervous headache arising from irritation of the eyes.

On the other hand, one often sees just the other extreme, that is to say, lamps so densely shaded that only a very small percentage of the light is useful. Sometimes this shading is done for æsthetic reasons, but in many cases it is done at the cost of both art and illumination.

The amount and character of the illumination must naturally depend upon the use to which the light is to be put. In a parlor, for instance, a moderate degree of light, well diffused, is usually the desideratum. In a library a stronger light is needed for reading purposes; a reading lamp with reflector is generally the most economical means of securing this strong light, but other illumination should always be superimposed in the room in such a case. In a dining room the illumination of the table is, of course, paramount, but here, as in the last case, the light should not be concentrated on the table to the exclusion of the rest of the room; the whole room should be moderately well lighted. The same general rule holds for the billiard room also. If the billiard table alone be brilliantly illuminated by localized light, as is often the case, the eye tires much quicker than if there be also a good general illumination throughout the room.

The value of diffused light is frequently overlooked or underestimated in planning the lighting scheme of a house. Even in cases where economy of lighting is an object, the laws of diffusion and reflection are often entirely ignored with the result that a great many more lamps than would otherwise be necessary are required in order to produce the needed illumination.

On the other hand, there are many cases in which the number of lamps installed is far greater than is required to give the necessary light. The electrical engineer or the architect, or whoever may be responsible for the lighting arrangements, often provides a large excess of lamps so as to be sure there will be enough. In so doing he takes no cognizance of the fact that when current is supplied by the lighting company, the average charge per lamp for lighting may be smaller or larger depending upon the number of lamps installed. It is not until the bill for current is received that the user realizes that his lighting arrangements are extravagant. He then learns that the charge for lighting per kilowatt-hour is based upon the number (or equivalent number) of hours his total lamp equipment is in use, and that the more current he uses within certain limits, the lower will be the charge per kilowatt-hour. As a matter of fact, however, he finds later that he seldom, if ever, gets the benefit of any reduction in charge, for the reason that in normal lamp service he does not use the equivalent of his total lamp equipment for a sufficient number of hours to obtain any reduction. Obviously, had the original lamp equipment been limited to what was necessary for the proper lighting of the establishment, the cost of lighting would be considerably reduced, to say nothing of the saving in the cost of installation.

It is not at all uncommon to find the total lamp equipment in residences to be at least fifty per cent larger than is actually necessary to give the requisite results so far as satisfactory illumination is concerned. And this statement is true not only of dwellings in which artistic and æsthetic considerations in lighting rather than economy of current are paramount, but also of those in which the decorative feature of the illumination is subordinate and subservient to economy.

In public buildings, art galleries, theatres, churches and large stores, the importance of careful design in the lighting arrangements is even greater than in the dwelling house. Although more attention is now being paid than heretofore in these cases, to the details of electric lighting, one still finds at every hand flagrant violations of some of the elementary principles of scientific illumination.

The question of electric illumination has grown too broad to be properly handled by the electrical engineer as such, or by the architect. The problems that present themselves for solution are numerous, and more or less complex and demand the attention of the specialist in illumination—the illuminating engineer, for whom the field is growing year by year.

Wireless Telegraphy in Canada.

At a recent meeting of the Marconi Wireless Telegraph Company, in London, it was stated that in view of the commercial demand between England and America a new station with the latest improvements had been nearly completed in Canada. With a reduced rate to sixpence (twelve cents) the directors thought two wireless stations would be fully employed during the year. Four stations had been equipped on the St. Lawrence, and a new contract had been entered into with the Canadian company, representing the extension of the organization of the wireless telegraph stations already established to the order of the Canadian government. Five stations also had been equipped at fishing centres along the Labrador coast. When other stations contemplated in Canada had been erected there would be a chain of stations, and they will afford the Newfoundland government direct wireless communication between the Labrador coast and Canada.

DRIVING TWO ALTERNATORS IN PARALLEL.

BY R. E. SPENCER GEARE.

Not long ago it was desired to run two alternators in parallel. They were seventy-five and 100-kilowatt machines of 3,300 alternations, and were wired up in such a manner that one was usually overloaded, while the other was running below normal load, and it was desired to synchronize them and thereby make one machine help to take part of the overload of the other; *i. e.*, to make the two act as one unit.

The alternators were belted to a jack-shaft which was driven from a 200-horse-power Corliss engine. The 100-kilowatt machine was driven by a twenty-four-inch belt, whereas the seventy-five-kilowatt machine was driven by a sixteen-inch belt. This would naturally bring in different "slips" to be figured upon.

It had been found impossible to parallel the machines satisfactorily, and upon investigation the synchronizing lamps showed that there was a difference of one and two-thirds revolutions in 550 revolutions per minute between the two. This tended to make one machine take more load than its share, whereas the seventy-five kilowatts should have taken three-sevenths of the load and the 100 kilowatts the remaining four-sevenths.

Right at this point it might be well to call attention to the fact that synchronizing lamps are the only possible means of determining exactly the difference in speed between two alternators. The revolution counter and tachometer are liable to variations from one to two revolutions, and too much dependence can not be placed upon their performance.

It was stated by an electrical inspector that if machines ran within one to one and one-half per cent of the same speeds they would act as gears, figuratively, when thrown in parallel, and the faster machine would tend to pull the slower with it, just as gears would do when meshed. He evidently disregarded the fact that in such a case a "wattless" or "cross-buck" current would be generated by the slower machine, which would make it impossible for the slower machine to take its share of the load, and therefore throw the greater part of the load upon the faster machine. This was the exact state of affairs when the machines were thrown in parallel.

It was desired to get the speeds of the machines exact, a state of affairs shown to be true when the synchronizing lamps remained lighted at the same brilliancy or remained out entirely, or when the synchroscope hand remained stationary. The circumference of the pulley was measured on the jack-shaft which drove the 100-kilowatt generator and the circumference of the pulley on the generator itself. The ratio between these was adopted as a constant. The circumference of the pulley on the jack-shaft which drove the seventy-five-kilowatt generator was measured. From the standard ratio adopted the proper circumference of the pulley on the seventy-five kilowatts was figured. Incidentally the circumference of the pulley in use on the seventy-five-kilowatt machine differed from the correct value by nearly two inches, of course precluding any figuring for slip. A new pulley for the seventy-five-kilowatt generator was ordered, the diameter called for being to the third decimal place. The rim of the pulley was made extra thick. The pulley was furnished as ordered and placed upon the generator.

On comparing the speeds of the machines it was found that there was a difference of one-third of a revolution in 550. This difference represented the loss of speed due to slip in the belts.

It was then a comparatively easy matter to take off a small cut from the thick rim of the new pulley and bring the machines to exactly the same speed. After this they operated in parallel very nicely, each taking its share of the load.

It is a dangerous experiment to figure on the slips beforehand in such a case. There are too many circumstances which enter the question. For instance, the question of belt-dressing, stiffness of belt, and tightness of the belt are things the influence of which can only be guessed at and therefore calculations involving these guesses are only approximate. It is far better to disregard the question of slip at first, where such exact speed regulation is required, and upon afterward determining it, make use of it, as was done in the case of reducing the size of the pulley on the smaller generator.

Commercial Electrical Engineering.

Mr. Charles F. Scott, chief electrician of the Westinghouse Electric and Manufacturing Company, contributed the following interesting editorial to the April number of the *Electric Club Journal*, upon the subject of "Commercial Electrical Engineering":

"'He must understand more about the customer's business than the customer himself, and he must know more as to what the apparatus will do than the designer himself.' Such was the reply of a man who was for a long time connected with the sales department of the electric company, when asked the principal qualifications essential in a commercial engineer. The man himself had handled many negotiations in which the engineering features were of great importance and he had, moreover, been in a position to observe the work of others.

"The engineering work of a large electric company may be divided under two general heads; the first is the design of apparatus and the issuing of specifications and data describing what it will do, the second is the selection and application of the apparatus to specific cases.

"The latter, which may be termed commercial engineering, is sometimes quite a simple matter; in other cases it is of the greatest difficulty and calls for the highest grade of engineering ability. It is not so much a knowledge of the theoretical elements involved in the design of the apparatus, a motor for example, which is needed, as a good practical knowledge of what the motor can do. This practical knowledge needs to be based upon a definite knowledge of what the motor can do on shop test, and upon good judgment—based upon experience—in the selection of a definite motor to meet the requirements under particular conditions which may be uncertain and indefinite and varying in character, an estimate which is very hard to express in amperes or horse-power.

"But why should an electrical engineer or an electrical salesman know the customer's business, too?

"Electrical work is seldom purely electrical. Electricity is simply an agent. It enters into other things as a means of accomplishing results. Hence, it enters into them vitally and intimately. Every department of a railway or a factory which adopts electricity may in one way or another be modified by it. Electrical engineering is related to all other kinds of engineering, steam, hydraulic, pneumatic, mechanical, civil, chemical. In order that the commercial engineer may effectively apply his apparatus and show that it can produce results, he must be thoroughly familiar with the business of which his electrical machinery is to form a part and which perchance it is to modify or revolutionize; hence, the need of a fundamental all-around common-sense knowledge of all kinds of engineering and all kinds of operation. Hence, the education of the engineer should not be a mere collection of facts but a development of engineering faculties. The education of the electrical engineer in college and in the apprenticeship course should lay a foundation in the fundamental principles of different branches of engineering in a training which will enable these general principles and general knowledge to be correctly applied in particular cases. In no branch of engineering is a broad general knowledge and the ability to apply and use such knowledge for specific purposes more necessary than in electrical engineering."

Platinum Resources of the United States.

On account of the increased demand for platinum the United States Geological Survey will make an examination of the platinum resources of the United States. It proposes to collect the heavy sands from all placer mines in the United States, where evidence of platinum has been found by preliminary tests. The samples thus obtained will be used in determining the best methods of extracting the various minerals which have economic value. In many places the separation and sale of these useful minerals, such as magnetite, chromite, garnet, monazite, rutile, topaz, zircon, gold, platinum, iridosmine, etc., may become a permanent and profitable industry.

As a preliminary step in this investigation owners of placer deposits are invited to mail to the office of the United States Geological Survey, Washington, D. C., not more than four pounds of material most likely to contain platinum in their placer deposit. This material will be carefully examined and the owners duly notified of the results. It is suggested that the gravel be concentrated as well as possible before mailing, care being taken not to lose any heavy material. There should be noted on the package, or in a letter accompanying it, or both, the total quantity of original gravel which the concentrate represents, in order that a general idea may be obtained of the value of the gravel for the purposes under investigation.

After an examination of these preliminary samples, experts will be sent to all localities where preliminary tests give promise of platinum in profitable quantity. The expert will report on the size of the deposit and superintend the collection of representative samples for concentration. Concentration experiments will probably be carried out in connection with the exhibits of mining machinery at the Lewis and Clark Centennial at Portland, Ore., between June 1 and October 15 of this year.

Each package of sand should be accompanied by exact information as to the name and post-office address of the sender, the name of the mine or claim from which it came, and the state, county, city, village, or district in which the deposit is located. On request, postal franks will be sent to owners of deposits in order that sand may be shipped without expense.

Great care should be used to pack the sand securely for transmission through the mails. It is preferable to sew up the sand tightly in a canvas bag, and tie the tag, which requires no postage, carefully to the package. No specimens will be examined unless the above information is given in regard to the exact locality from which the samples have been obtained.

The director of the Geological Survey will appreciate all information which can be given as to the efforts previously made to separate platinum from the sands in neighborhoods, and as to the quantity of platinum produced in the district.

Platinum has been discovered in California, Oregon, Idaho, Montana, New York, North Carolina, Georgia, Pennsylvania, Wyoming and Alaska, in the United States, and in Canada, Mexico, Central America, the West Indies and South America.

BOOK REVIEWS.

"Experimental Researches on the Flow of Steam through Nozzles and Orifices," to which is added a note on the flow of hot water. A. Rateau, engineer of the mining corps, professeur à l'Ecole Supérieure des Mines de Paris. Authorized translation by H. Boyd Brydon. New York. D. Van Nostrand Company. Cloth. 74 pages. 5¼ by 7½ inches. 3 figures and 4 plates. Supplied by the ELECTRICAL REVIEW at $1.50.

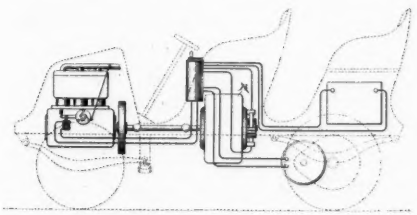
In 1892 Professor Rateau published in the *Annales des Mines* the results of his experiments on the flow of steam through nozzles and orifices. Previous to that time other investigators of this important subject, both in Europe and America, had employed practically the same method of research. It consisted of condensing the steam after passing through the nozzle under test in a surface condenser, and then weighing the water obtained during a certain lapse of time. This method, however, presents many inconveniences and sources of error. Rateau described an indirect method he used in which all readings were completed in a very short interval of time. This enabled the experiments to be made rapidly and precisely. Rateau employed the greatest care in his experiments and the total accidental error in the calculated results could not exceed one per cent; the mean error was probably not more than a few thousandths of one per cent. The result of Professor Rateau's experiments showed that with very careful work the same coefficient of discharge is obtained as Grashof gave in his formula which was derived from pure thermodynamic calculations. The translation of this article into English gives to a great many English reading engineers an important book on a subject found in but few books in the English language. It will be especially of value to those interested in steam turbine design, for Rateau undertook these experiments when he was beginning his study of the steam turbine.

"The Insulation of Electric Machines." Harry Winthrop Turner and Henry Metcalf Hobart. New York. The Macmillan Company. Cloth. 298 pages. 6 by 9 inches. 162 illustrations. Supplied by the ELECTRICAL REVIEW at $4.50.

This is the first book to be published on this most important subject. Usually, texts on dynamo electric machinery dismiss the subject of insulation with a page or two, or more frequently hardly mention it at all. As a matter of fact, the subject is one of vast importance to both the designer and the operator of electrical apparatus, as nine-tenths of the ultimate breakdowns in electrical machinery are due to the breakdown of the insulation, no matter what the primary cause of the trouble. The work of Turner and Hobart is therefore very timely, and makes a valuable contribution to the subject. This work is more an exhaustive compilation of information bearing on the subject from papers, trade publications, etc., than a text laying down the fundamental principles of design. Existing materials and methods of using them are well described, but the application of materials to particular work, such as, for instance, transformer design, is not taken up to any extent. In this respect the book will be rather disappointing to the designing engineer. On account of the nature of the subject, it has, of course, been necessary to make considerable use of trade names of materials and to describe these at some length, and in this connection the trade publications of the companies furnishing such materials have been frequently quoted for directions and information concerning the materials described. Very little attention has been given to the question of the testing of insulating materials and apparatus for making such tests. The curve work in the book is of the roughest character, amounting to little more than free-hand sketches, and this detracts much from the appearance of the book as a whole. The metric system has been used throughout in connection with all distances, which will be somewhat awkward to the average American engineer, as he will have to translate to the units with which he is familiar. This work is, however, a most valuable contribution to the subject, giving, as it does, the first logical and comprehensive outline of the general subject. Although the book is of English origin, American writers on the subject have been freely quoted, and in all cases of quoted material full credit has been given. The bibliography in one of the final chapters will be found of especial value to those who wish to study the subject further.

Electrical Patents.

Lars G. Nilson, of New York, N. Y., has assigned to the Fischer Motor Vehicle Company, of New Jersey, a patent recently granted to him on an electrogasoline vehicle (786,376, April 4, 1905). The invention has special reference to such vehicles as are driven by electricity, and the objects are to provide improved controlling and operating mechanism, and in vehicles of the type which employ an engine driving a dynamo, a motor or motors and a storage battery so arranged as to permit the dynamo to supply both the motor and the storage battery and to permit the battery to supply the motor as an auxiliary to the dynamo, to provide means whereby the charging of the batteries and the output of current from the dynamo may be automatically regulated according to the demand for current, and means whereby the motors may be readily controlled to operate as motors, as braking means, or as battery-charging means. Mr. Nilson prefers to provide

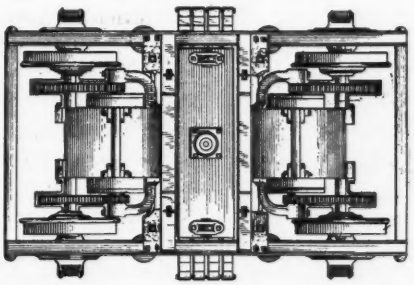


ELECTROGASOLINE VEHICLE.

a main and an auxiliary controller, the main controller regulating the ordinary running speeds of the motor and an auxiliary controller regulating the operation of the motor, as a braking, or as a charging means, and to prevent accidents provide means whereby the auxiliary controller will be inoperative except when the main controller is in certain positions.

Mr. Henry H. Cutler, of Milwaukee, Wis., has secured fifteen patents on electrical apparatus, the majority of which have been assigned to the Cutler-Hammer Manufacturing Company, of Milwaukee, Wis., the remainder having been assigned to Arnold Magnetic Clutch Company, also of Milwaukee, Wis. The various structures covered relate to systems for controlling electric motors, power-transmission mechanism, speed-varying means, and magnetic clutches.

One of these patents relates to a system for operating electric vehicles (786,419, April 4, 1905). The invention relates to improvement in alternating-current motors and means for connecting the same with a driven mechanism, the object being to provide an alternating-current motor for operating electric vehicles, electric railway trains, interurban railway trains, electrically driven boats, and any devices which are adapted to be driven by electric motors, and to provide means for connecting the same

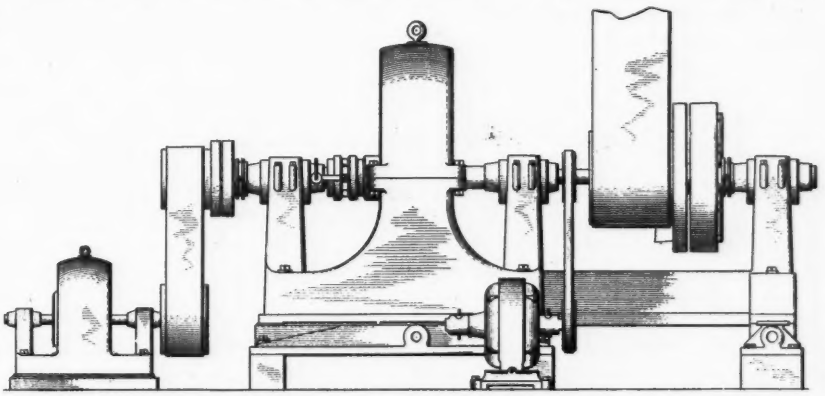


SYSTEM FOR OPERATING ELECTRIC VEHICLES.

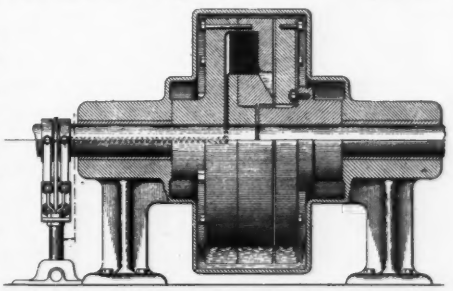
with the driven mechanism thereof, whereby the motor may operate independently of the driven machinery and be connected therewith without undue strain upon the motor or the parts driven thereby. In carrying out the invention, the driving-wheel of an electric vehicle is provided, also an alternating-current motor for operating the same and capable of running independently thereof. A controlling circuit has electromagnetic windings connected therewith, which windings are adapted to respond to variations in voltage. Suitable instrumentalities are adapted to be operated by the windings to control the operation of the motor. A clutch is employed for connecting means with the motor to drive the wheel at one speed, and a second clutch connects means with the motor to drive the wheel at a relatively higher speed. Suitable means are provided for supplying a direct current to the controlling circuit and the clutches, also means for varying at will the voltage impressed upon the controlling circuit.

Another patent has particular reference to a synchronous motor and clutch mechanism associated therewith (786,417, April 4, 1905). The invention relates to alternating-current power-transmitting apparatus, and the object is to provide means whereby a synchronous alternating-current motor may be employed to efficiently and economically start and drive its load without strain upon the power-transmission system and also to provide means whereby the part driven by the motor may be caused to rotate at any desired speed at will. In the embodiment of the invention, the rotor of a synchronous alternating-current motor and the load thereof is provided, and a magnetic clutch is arranged to introduce inductive and frictional slip between the rotor and its load. The slip is controlled by suitable means so that the load may be brought to full speed without undue disturbance of the electrical supply circuits.

A third patent covers a magnetic clutch or speed accelerator (786,411, April 4, 1905). The object of the invention is to provide an electromagnet element whereby a driven part may be rotated at any desired speed equal to or less than that of the driving part. A primary winding is provided having suitable energizing windings. A secondary member is adapted to be inductively influenced thereby to create torque producing currents in the secondary member, whereby relative movement between the primary and secondary members results, these members being axially movable relatively.



SYNCHRONOUS MOTOR WITH CLUTCH.



MAGNETIC CLUTCH OR SPEED ACCELERATOR.

MECHANICAL CONSTRUCTION OF STEAM TURBINES AND TURBO-GENERATORS.[1]

BY W. J. A. LONDON.

The bedplates of large turbo-generators should be of some moderately inelastic body, such as concrete, or brick and cement, and should extend the whole length of the turbine bedplate. Steel or iron constructions in foundations are not to be recommended as they invite trouble, due to vibration.

In the Parsons and Westinghouse turbines expansion takes place in the revolving blades as well as in the stationary blades. This calls for final radial clearances. With a drum type of spindle the loss by radial clearance space is somewhat larger than is the case with a disc type of machine, but skin friction is reduced to a minimum, there being no big areas revolving in media of different densities.

Owing to the difference of pressure between the two sides of the rotating vanes in a Parsons turbine, the whole annulus must be filled with steam so that small diameters and low velocities have to be resorted to where its density is very high, in order that the percentage of clearance to blade height will not be excessive. As the steam expands, its volume increases, and as the number of rows or blades varies with the square of the velocity, it is advantageous to step up in the diameter of the spindle as soon as possible. Various designs have been tried for these spindles, one type being shown in Fig. 1A, which consists of a plain forged steel drum having ends pressed into it of high carbon, or nickel steel. The steps are taken care of by a series of cast-steel rings. This type of spindle has the advantage that the forged steel body in itself is more homogeneous than the casting, and consequently is less likely to cause balancing troubles. The cast-steel rings can each be separately balanced and shrunk on. The disadvantage to this type is the number of parts necessary to make the whole, and the amount of machining and fitting necessary, which makes this construction somewhat expensive. Messrs. Parsons now use the type of spindle shown in Fig. 1B for all their designs, using cast steel for the drum. With spindles of this design balancing troubles are often very serious, it being impossible to guarantee absolutely homogeneous material, and on account of the weakest section falling midway between the bearings whipping is likely to occur, due to unbalanced mass.

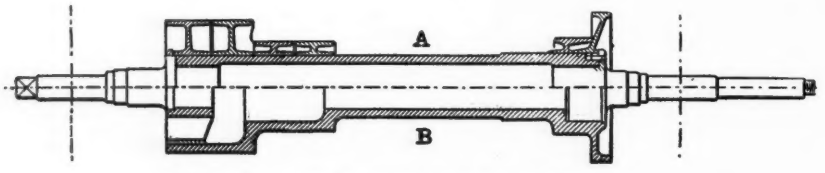


FIG. 1.—CONSTRUCTION OF TURBINE SHAFTS.

The design of the stationary part of a Parsons turbine is a very important item, especially with large machines. As the diameters increase the greater is the tendency for distortion. Further, the cylinder can not readily be supported between the bearings, owing to the fact that the centre part of the cylinder is at a higher temperature than the two ends, and the consequence would be that the cylinder would lift in the centre; this is exactly what must not take place. Further, any support or irregularity cast on to the part of the cylinder that must remain concentric at once causes distortion, and makes the cylinder elliptical or otherwise out of truth. It is, therefore, clear then that no rigid supports can be placed in the cylinder between the bearings. If ribs are necessary for stiffening on the under half they should be duplicated on the top half.

The British Westinghouse Company, between two and three years ago, when entering the field of turbine manufacture, arrived at the conclusion that the most successful turbine should combine the principles of action and reaction. The objections to building turbines on the straight Parsons principles lay in the great overall length, mechanical difficulties in the construction of the spindle, and the adoption of dummy packing rings to eliminate end thrust. By making the turbine double flow—that is, by admitting steam in the centre and passing same through equal rows of blades on each side—end thrust and dummies were eliminated, although the overall length of the machine becomes much greater than that of a straight Parsons turbine; further, the initial blade height would only be half the length of a single flow. This limiting blade height again would necessitate the stepping of the spindle.

In expanding steam from 160 pounds absolute to twenty-seven inches of vacuum, the available work in heat units is 325 per pound, in expanding from 160 pounds down to sixty pounds absolute, the available work is 78.9 British thermal units, or about twenty-four per cent of the total work in the whole expansion. In view of this it was considered that a slight decrease in efficiency might be allowed in the high-pressure end of the turbine if considerable mechanical improvements could be effected thereby. By adopting a combined impulse wheel for the expansion from boiler pressure to about sixty pounds absolute, it was found that the velocity necessary for the wheel fixed such a diameter that Parsons blading could be successfully used on the one diameter already determined by the velocity of the impulse wheels. The specific volume of the steam at sixty pounds pressure was so much increased from boiler pressure that the initial blade height on a large diameter was not prohibitive. The result of this combination is that a machine can be built which is very much shorter than the Parsons machine for given conditions, at the same time maintaining the high degree of efficiency. With this type of machine skin friction of the discs of the ordinary impulse type of machine is eliminated. The efficiency of the compound impulse section is comparatively high, but perhaps not so great as the remainder of the machine; this again is probably balanced by the losses due to skin friction in the long high-pressure end of the Parsons machine.

A longitudinal section of a British Westinghouse turbine is shown in Fig. 2 and the design allows of forged steel being used throughout in the construction of the rotating members. A centre shaft of high-carbon steel extends from one bearing to the other, on which is shrunk the disc supporting the blade-carrying drum. The centre disc is of forged steel and the outer drum is of weldless rolled steel. This outer drum carries the impulse blades in steel rings which are shrunk on. The Parsons blading is carried directly in grooves in the main drum. Stiffening discs of thin steel are also fitted into the ends of the drum. A spindle of this construction is extremely stiff, and having a thorough-going shaft there are no joints in the spindle likely to give way and cause trouble. The stresses due to centrifugal force in a reasonably thin drum can be reduced

[1] Abstract of a paper read before the Manchester, England, local section of the Institution of Electrical Engineers on February 28.

mathematically to the following simple equation: $C=MV^2$, where C=centrifugal force, M=mass of material, V=mean velocity in feet per second.

A further simplification of this formula, which, when considering steel or other material of similar density, is near enough for rough calculations only, is this kind for the end bells, it is advisable, where possible, to use rolled material.

The method of building up the commutator now adopted in nearly all continuous-current turbo-generators is as follows: the segments are built up with intervening layers of mica and clamped together. The mica is then tied round the outside have sufficient cross-section to carry the current without undue heating. In order that it may become apparent when it is time to stop truing up the commutator, a series of notches or grooves can be placed along the commutator segments indicating the limits for truing up. All overhanging mica, etc., should be turned off, as this

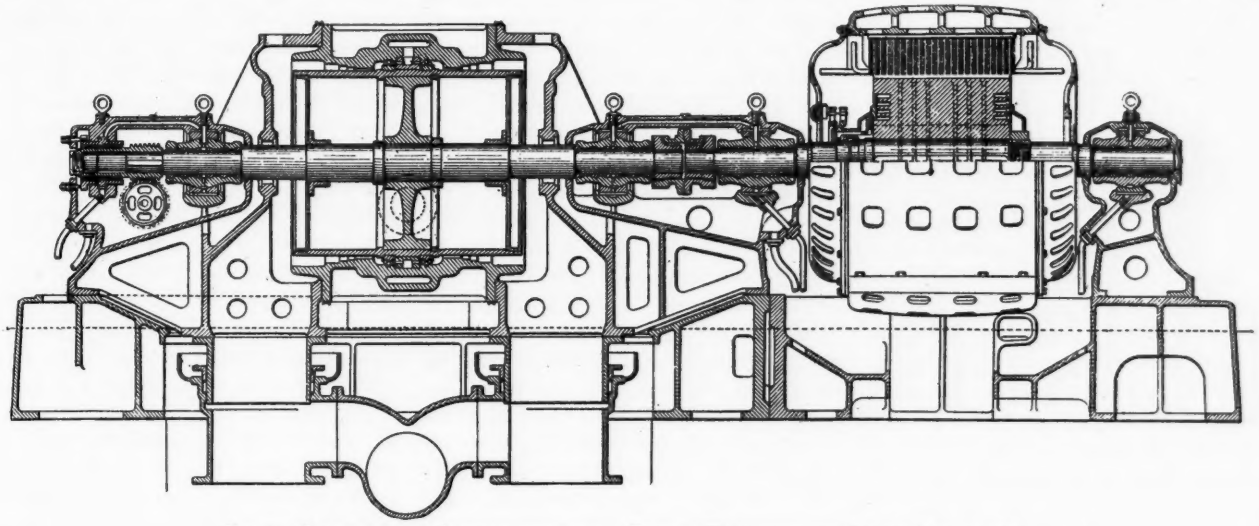


FIG. 2.—LONGITUDINAL SECTION THROUGH A BRITISH WESTINGHOUSE TURBO-GENERATOR.

$C_1 = V^2/10$, C_1 in this case being the stress per square inch. The radius has no effect on the centrifugal stresses (other than loading by the blading), and the peripheral velocity is, therefore, the limiting feature.

Special construction of the generator is necessary to cope with the speeds demanded by this class of prime mover. The majority of continuous-current generators to-day are constructed with semi-enclosed slots, a keypiece being driven in on top of conductors. This construction is satisfactory for the core of the armature, but the end windings require some other method of support. Fig. 3A shows one method of end winding with binding wire. This construction, as will be seen, is so designed that where the heaviest load comes on the conductors the thickness of binding wire is greatest. The alternative to the above construction, now generally used, is shown in Fig. 3B, the end winding being kept in position by bronze end bells. This construction has the advantage that repairs can be readily attended to. The greatest difficulty so far that has been experienced with this class of end bell is the procuring of suitable material. With cast bronze it is difficult to ensure the material being homogeneous; and, further, the physical properties are never so sure in this class of material as in the case of binding wire or forged material; so that, in a construction of at the place where the shrink rings are to be fitted, the steel rings then shrunk on and the whole machined inside and out. The commutator is then supported on cones at each end, which fit tightly on to the shaft. Owing to the wear that is bound to take place on such commutators, allowance must be made so that when the

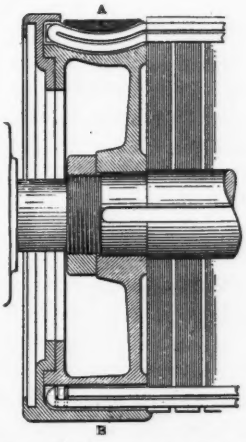


FIG. 3.—METHODS OF SECURING THE END-CONNECTIONS OF ARMATURE WINDINGS.

commutator is worn down to a certain extent, the segments do not become too weak to support themselves between the rings, and, in consequence, bulge out, causing high bars. To eliminate this a good scheme is to design the bars so that at, say, half the original depth, they are stiff enough to carry themselves rigidly, and has often been found to give trouble by collecting dirt. Everything throughout should be so designed that when running there is as little unbalanced mass as possible, and where keyways are cut in the shaft, two should be provided diametrically opposite, in order to keep the shaft itself as uniform as possible. Provision should be made in all armatures for the speedy application of balance weights.

It has been found that it is almost impossible to use carbon brushes on turbo-generators, owing to the fact that the armature floats when running, thus causing the brushes to dance. Metal brushes must, therefore, always be used, and, in consequence, unless commutating poles or compensating windings are adopted, the position of the brushes must be altered to suit small variations of the load. In all modern turbo-generators commutating poles or compensating windings are adopted, thus ensuring fixed lead.

During the last few years the demand for large turbo-alternators for high voltages has necessitated the adoption of the rotating field type of alternator. The rotating field may be built up of (1) laminated plates; (2) slabs of forged steel, say, about two inches or three inches thick; (3) solid core with poles bolted on; (4) one solid piece.

All the above constructions are now adopted by different makers. In large machines the peripheral velocity amounts

to something like 300 feet per second. The British Westinghouse Company, in its design for the 5,500-kilowatt turbo-alternators for the London Underground Railway Company, adopted the solid construction. These rotors run at 1,000 revolutions per minute. The outside diameter is sixty-seven and five-eighths inches, and the peripheral velocity of the pole-faces 294 feet per second. The field itself is a solid forging of Whitworth fluid-compressed steel, the centre being bored out to admit the high carbon steel shaft. The sides of the poles are milled out to admit the windings, ventilating ducts being also milled out. The solid pole construction materially stiffens the shaft, and, as the whole length of the poles themselves can be taken as being absolutely rigid, the only deflection that takes place is between the ends of the poles and the bearings. To reduce as low as possible the loss by windage smooth cores should be adopted where possible. In order to obtain ample ventilation two totally different methods may be adopted: (1) as much exposed surface and free air way as possible; (2) machine entirely enclosed with forced ventilation.

Both these systems are now extensively used, and it is hard to decide which is preferable. The first has the advantage of being more efficient, but has the objection of being noisy. The noise is almost entirely eliminated in the enclosed machine, but tests have shown that, with this type, to obtain sufficient ventilation, a considerable amount of power is absorbed by the blowers, resulting in a somewhat less efficient machine.

In turbine bearings we are confronted with the following conflicting conditions: on the one hand, the shaft should be sufficiently strong and rigid, necessitating large diameter journals, and the bearings must be sufficiently long to keep the pressure per square inch low, to allow of the oil being constantly renewed round the journal. On the other hand, the circumferential speed of the journal must be kept as low as possible to reduce friction. In order to make the whole length of the bearing effective, this length must not be excessive. For small turbines and generators with high speeds down to about 2,000 revolutions per minute the bearing almost universally used consists of a series of concentric tubes fitting loosely over one another, the intervening cylindrical spaces being filled with oil. For large machines, however, with speeds below that mentioned, the rotating elements can be sufficiently well balanced to run smoothly in solid bearings. The small bearings referred to above are invariably of bronze, but with solid bearings, cast iron, white-metal lined, have shown themselves to give excellent results. Even with large bearings for the comparatively slower speeds the bearings must be allowed a certain amount of give; this can be done either by easing off the brushes toward the end or fitting the whole bearing into a spherical seat. With white-metal bearings the danger, of course, lies in their running out should the oil supply at any time fail. With bronze bearings the effect would be very severe seizing of the shaft, doing possibly a considerable amount of damage to the whole spindle. With good white-metal bearings the writer has seen the oil supply fail, the only result being a slight wearing of the bush, causing no damage whatever to the shaft. As regards the metal for the journal itself, the experiments of Herr O. Lasche, of Berlin, go to prove that the metal employed, whether of nickel steel, Siemens-Martin steel or mild steel, has little influence on the degree of friction. With regard to the degree of smoothness and to the facility for taking a highly polished surface, Herr Lasche points out that microscopic examinations of the outside faces, even with magnifications of 100 times, did not reveal any great difference in their structure. The coefficient of friction for mild steel was found to lie between those of the harder materials, Siemens-Martin and nickel steel. The experiments clearly show that there is no great gain by using nickel steel. Further, the nickel steel, after a somewhat prolonged service, showed larger pores than a mild steel journal of equal service. The effect of clearance has a marked influence on the efficient working of turbine bearings. It also has a large influence on the amount of total friction and also on the running and safe working conditions. In bearings with small clearances a relatively great amount of power is required to overcome the friction, even if the shaft is not very heavily loaded. Friction between the shaft and the oil, between the oil and the bushes, and between the oil particles themselves has to be overcome. In consequence it is better to ease the bearings considerably on the upper half; this materially decreases the friction and allows much smoother running. If the shaft is well balanced the upper half of the bearing can be entirely dispensed with, and this is practically done in many instances, a clearance of one-sixteenth inch being allowed on the top half of the bearings. However, should the shaft have any tendency to whip, an uncovered bearing of this kind leads to trouble, as it offers no resistance to the shaft moving laterally. For this reason instead of cutting the whole of the top of the bearing away it is safer to allow a strip of the bearing to remain along the top, thus holding the whole shaft.

The peripheral velocity in turbine bearings is necessarily very considerably higher than in ordinary steam engine practice, velocities of fifty feet per second being regular practice. The load per square inch, however, must be kept very low. In steam turbine practice to-day it is usual to allow a constant of 2,500 for the peripheral velocity in feet per second multiplied by the pressure per square inch on the bearings. This in some cases is raised as high as 3,000. Experimental bearings have been run, however, with a peripheral velocity of seventy feet per second and a pressure of seventy pounds per square inch, thus giving a figure of 4,900. The crux of the whole question is the facility for dissipating the heat, and for this reason as much of the bearings as possible should be in contact with the outer walls, provided, of course, that the outer walls themselves are also free to dissipate heat. Water-cooled bearings are very often resorted to in very large machines, the principal advantage of these being that in a turbine of the Parsons type the heat from the high-pressure end of the turbine is transmitted to the bearing, the water-cooled bearing, therefore, isolates this heat from the bearing proper. In machines where there is no close contact with steam-heated surfaces, the bearings working within the limits mentioned —*viz.*, from 2,500 to 3,000 for potential voltage can run satisfactorily without water cooling. An ample oil supply, however, should be given; in fact, the supply of oil in turbine bearings should not be restricted. In steam turbines the oil leaves the bearings uncontaminated by water or other matter, and can be returned to the cistern and reused, so that there is little loss by providing an ample oil supply. The usual European practice in turbine work is to allow about 0.05 gallon per square inch of bearing surface per minute. Ball bearings at moderate speeds give excellent results, but they do not stand the test of high speeds; they are noisy even with small balls. This is very pronounced when the peripheral velocity of the revolving body is about thirty feet per second, so that on the whole they are not suitable for high speed work, nor are they as safe as the plain bearing.

To reduce the troubles arising from im-

perfect balancing to a minimum, the following points must be taken into consideration in the design of the machine: (1) the materials adopted should be as homogeneous as possible. (2) The design should be absolutely symmetrical. (3) Where possible all parts should be machined inside and out with the greatest accuracy. (4) The shaft must be sufficiently stiff to resist undue whipping. (5) Special care must be taken with the windings and insulations to ensure rigidity when running. (6) Where possible the normal running speed should be below the "critical speed." If this is not possible the normal speed should be reasonably higher, so that the critical speed, except when running up or shutting down, is never reached in ordinary operation.

Where possible forged steel should be used throughout in the construction of the rotor; if this is adhered to considerably less trouble is likely to present itself than would be the case were castings used. In connection with the design of a shaft of sufficient strength to resist whipping, the length between the bearings should be kept down to a minimum. This length, however, is determined by the maximum peripheral velocity allowable on the rotor. With turbine spindles of the Parsons type the ratio of the length between centres of bearings to the diameter at the centre of the shaft is often as high as eleven, and in small generators six to eight. It is often necessary, therefore, to apply balance weights at, or about, the centre as well as at the ends before smooth running can be accomplished. In continuous-current machines provision is therefore often made for applying balance weights to the inside ring of the commutator. With rotors for 1,000-kilowatt generators and upward, this ratio rarely exceeds three, and in the majority of cases in very big machines about 2.5. With this ratio balancing troubles, with the reasonably low speeds now adopted, are never very serious. One of the greatest troubles experienced in maintaining good balance of turbo-generators is due to the shifting of the conductors. This often happens after the machine has been running some time and as the insulation dries it gets compressed by the centrifugal force on the conductor. The slightest shifting of these conductors is likely to throw a big rotor considerably out of balance. Should the machine at one time or another run away and attain the speed of, say, one and one-half times the normal running speed, the severe load resulting is often sufficient to throw the whole rotor out of balance. In all bodies revolving at high speeds there is a period at which excessive vibration will take place, and is called the "critical or whirling" speed. It coincides with a point at which the natural period of transverse vibration of the shaft loaded with the rotating element is equal to the impulses given to the shaft by the centrifugal force acting on a slightly bent shaft; at this speed steady operation of the shaft is impossible. Mathematical investigations of this phenomenon have been carried out and published by Professor Dunkerley and others.

The critical speed for any shaft is given by Foster as: $N = 9.55 \sqrt{F g / W}$, in which W = weight of rotating mass and a portion of the shaft, and F = force in pounds weight necessary to bend the shaft one foot at the point of attachment of the wheel.

The above formula is for a shaft of diameter D feet.

Then $F = 3EI\ (a + b) \div a^2 b^2$, in which E = modulus of direct elasticity in pounds per square foot; I = moment of inertia of the cross-section $= 0.0482D^4$; and a and b = distances in feet of the wheel from the bearings.

The following formula is given by Behrend for turbo-generators: $N_1 = \sqrt{KEI \div ML^3}$. In this case N_1 is the angular velocity at critical speed, E = the moderation of elasticity; I = moment inertia of the shaft in relation to bending; M = mass of rotating element; L = distance between bearings; K = constant whose value is about seventy-five.

Where possible, in the construction of the rotating parts, for turbo-generators, static balance of the respective parts should always be resorted to before assembling. Again, the whole body should be statically balanced before being run; although, of course, it does not necessarily follow that, if it shows perfect balance on the knife edges, it will be correctly balanced when running. In balancing, if the rotor is considerably out of balance, one is very often much tempted to apply considerably more weight than is necessary. If the weights are applied at the periphery of the body, which has a velocity of, say, 300 feet per second, at a radius of one foot, that actual weight applied is multiplied by the centrifugal force 3,000 times. Very small weights, therefore, have considerable effect in throwing the whole body back into balance.

First Electric Railway in Manila.

The electric street railway in Manila, P. I., was formally opened for traffic on April 10.

Official Catalogue of the Exhibition of the German Empire at the Louisiana Purchase Exposition.

The official catalogue of the exhibition of the German Empire at the International Exposition, St. Louis, 1904, has been published. This book is edited by Imperial Commissioner Lewald, and a large portion of it is devoted to a great variety of introductory articles written by men of prominence in their several professions, on trade, industrial and economic conditions in Germany. This material is freely interspersed with statistical and historical data. The list of exhibitors proper occupies less than one-half of the volume. There is a fine plate in colors of the exhibition grounds. The introductory matter, among other valuable articles, contains the following: "Scientific Chemistry in Germany," Dr. Harries, professor, Berlin; "Physics and Kindred Sciences," Dr. Lindeck, Charlottenburg; "German Chemical Industry," Dr. Otto N. Witt, Berlin; "Engineering," Karl Bernhard, Charlottenburg; "Machinery," Wilhelm Hartman, Berlin; "Electrotechnics," G. Klingenberg, Charlottenburg; "Motor Cars," Wilhelm Hartman, Berlin; "Railways," Fritz Herr, Berlin. The volume is splendidly printed in several colors, and is durably and handsomely bound in illuminated sheepskin.

The whole volume reflects a great deal of credit, both upon the editors and those interested in its mechanical development.

The Imperial German Consulate General, at New York city, has a limited number of copies on hand for free distribution, upon written application. Express charges, however, must be borne by the recipient.

Directors' Nominees for Officers for 1905-'06 of the American Institute of Electrical Engineers.

The directors of the American Institute of Electrical Engineers have announced the following nominations for officers for the term of 1905-'06:

President—Dr. Schuyler Skaats Wheeler.

Vice-presidents—Charles A. Terry, Townsend Walcott, Gano S. Dunn.

Managers—C. C. Chesney, Calvert Townley, Bancroft Gherardi, Charles L. Edgar.

Treasurer—George A. Hamilton.

Secretary—Ralph W. Pope.

Balloting is now going on, and election announcements will be made at the annual meeting, which will be held at Carnegie Hall, New York city, May 16, 1905.

Reviews of Current Engineering and Scientific Literature.

An Automatic Block System.

A description is here given of the automatic electric block system now used on one of the Austrian railways. The system is operated by means of an angle-bar about twenty-five feet long, which is placed alongside of and touching the running rail. This angle-iron is on the inside of the track, and is held in place by four springs. When a train passes, the flange of the wheel enters between the rail and the angle-iron, forcing them apart, and in this way closing two contacts which are operated by a rod pressing against the angle-iron. The closing of this circuit actuates the block apparatus. This consists of an electromagnet, above which is suspended an armature. The armature is attached to one arm of a three-armed lever. The second arm of this serves for attaching a spring. The third arm is curved, and bears a pawl which engages in a ratchet wheel attached to a commutator. When the armature is drawn down by the electromagnet, the movement of the lever throws the commutator around. This starts a one-eighth-horse-power series motor which is mounted on the signal post, and which, in turn, operates the semaphore. The motor is geared by means of a sprocket wheel to a sprocket chain carried by two arms of the operating lever.—*Translated and abstracted from the Elektrotechnischer Anzeiger (Berlin), March* 23.

Steljes's Telegraph System.

A description is here given by M. F. Poncelet of Stelies's automatic telegraph system, which, it is said, has been used with such excellent results by the Russian army during the present war. The advantages of this system are its secrecy, since the receiver has been arranged so that it may be securely locked up in a case; no battery is employed, the necessary current being supplied by a hand-operated magneto of special form. This magneto operates, at the same time, a system of contact levers, which, in connection with the keys of the instrument, effects the signal. The sending device consists of a circular table, around which are arranged a series of keys corresponding to the various letters of the alphabet. When one of these keys is depressed and the handle of the magneto turned at the same time, the arrangement of contacts is such that the circuit is completed, while on a dial are contacts which send out impulses corresponding to the letter. Numerals are sent in the same way by using the same keys and a shifting lever. Any person may use the device in order to send a message. This is an important advantage for war purposes. Two or more messages may be sent over a wire at the same time, or a number of receivers may be connected to the wire and receive the same messages. The speed of the messages necessarily depends upon the skill of the operator.—*Translated and abstracted from L'Électricien (Paris), March* 18.

The Electrical Equipment of Messrs. Harland & Wolff's Shipbuilding Works.

There is being completed at the shipbuilding works of Messrs. Harland & Wolff, in Belfast, Ireland, one of the largest examples of electric driving in the United Kingdom. Mr. J. W. Kempster, who is in charge of the electrical department of this company, has designed and carried out the whole of the conversion to electric driving, including the erection of the power-house. The two most interesting features of the equipment are the employment of both continuous and three-phase current for driving, and the adoption, in almost every shop, of individual driving for the machines, so that an enormous amount of belting and contershafting has been displaced. The chief object in view has been to obtain a maximum output from every machine in every shop. Twelve hundred brake horse-power is supplied by three-phase current, 800 horse-power in continuous current for power purposes, and 1,000 horse-power for lighting. When the electrical equipment of the entire works is completed, at least another 1,000 horse-power will be added. Three-phase current is supplied at 450 volts to the different shops, and preference is given to this system wherever the conditions permit. It has been estimated that the repair bill of the three-phase motors is some twenty-five to thirty per cent less than that for continuous-current motors. Continuous current at 450 volts has been employed for cranes, winches, etc., and for cases in which reversible or variable-speed motors have been called for. The power station is 469 feet long by sixty-eight feet wide. The ground consisted chiefly of saw-mill refuse and soft mud, extending in some parts a depth of from twenty feet to twenty-five feet. Piling was therefore necessary for the foundations, and the main and division walls are carried on about 1,000 larch piles, thirty-five to forty feet long, with ten-inch by nine-inch timber rafts secured to the top of the piles. Concrete footings are laid on and embedded around these rafts. The piles for the engine and chimney foundations are 500 in number, and are twelve inches square pitch pine forty feet long. Under the engine pits the piling was surmounted by eleven-inch by three-inch channel iron, interlaced so as to throw an equal portion of the weight on each pile. There are five boilers of the single-ended marine type, each having a heating surface of 2,225 square feet, and a grate area of 56.75 square feet. Their diameter is fourteen feet eight inches, and their length, ten feet six inches. Space is provided for five more boilers of similar size. Steam is generated at a pressure of 200 pounds per square inch. The engines exhaust into surface condensers, and town water is employed for the make-up feed. The mean temperature of the feed water as supplied to the boilers is 212 degrees Fahrenheit. No economizers are employed. For the main generating plant, horizontal Sulzer engines and Lahmeyer dynamos have been selected. One of the three 1,000-horse-power engines drives a three-phase generator, and both continuous and three-phase machines are connected to each of the other two. These two machines have a capacity of 650 kilowatts, so that the engine can drive one of its two generators at full load, and the other partially loaded, or both at about three-quarters full load.—*Abstracted from the Electrician (London), March* 10.

The Use of an Auxiliary Dynamo for Controlling an Accumulator Installation.

There are many small plants, says Herr B. Jacobi, which might effect an economy in operation by using an auxiliary dynamo for controlling the output of a storage battery installation at night, thus enabling the steam plant to be shut down. This is particularly true for plants which supply current for railways and for lighting at the same time. It is gen-

erally supposed that to effect this it is necessary to install two batteries, one for the railway, and one for carrying the night load. This, however, is not the case, for by inverting the rotary converter and its auxiliary booster, the supply may be drawn from the battery and sent out over the ordinary high-tension supply lines. Two cases are then considered and the necessary connections explained in detail. First, a rotary converter and booster are used for charging the batteries, and, when inverted, for supplying the night load. In the second case a three-wire, direct-current system is run in connection with a railway. Here two machines are necessary, drawing a supply from a battery, transforming it, and sending it out over the lighting mains. The switch arrangements in each case are not complicated, and the saving in coal over the method in which a steam plant is run at light loads is considerable. The energy loss in the machines is not great, hence they can have high efficiency. —*Translated and abstracted from the Elektrotechnische Zeitschrift (Berlin), March* 9.

The Telephone System in Riga, Russia.

A description is here given by Mr. Clarence Bosworth of a modern telephone installation at Riga, Russia. The telephone service in this city was formerly given by a Bell company. The Bell franchise having expired in 1904, an independent company acquired its equipment, and has since put in an entirely new plant, bringing the city's telephone system up to date in all respects. This city is the largest in the Baltics, having a population of something over 250,000. The people are not Russians, but are of a different race, and resemble more nearly the Germans. They are well educated and well advanced industrially. The new installation is designed for 10,000 subscribers. At the present time there are 6,000 telephones working. At each end of the board additional panels are placed, so that each operator can reach all of the multiple jacks. Each section of the board has six panels, arranged upon the three-operator multiple plan. In front of each operator are160 answering-jacks with sixteen pairs of cords, plugs and keys. The switchboard is of the common battery automatic-signaling type. The ringing apparatus is semi-automatic, and so arranged as to ring the subscriber continuously for three seconds, after which the ringing key automatically restores itself. Large dials are placed over the top of each operator's position. These record the number of connections made by the operator. They are not intended as meters, but merely as a check on the operator's work. The chief operator's desk is arranged with lamps for each operator, and a listening-jack, so that complete supervision is effected. The work of each operator is watched for a certain number of hours each month at unfixed times, and this serves as a check on the dials. At the present time twenty-one positions are served at the switchboard, but the number of subscribers is growing rapidly. The rates for labor are about the same as in the United States. One feature of the distributing board is the double-test jack for each line on the switchboard side of the rack, which is convenient for the purpose of facilitating the location of trouble by inserting a double plug into this jack, the wire chief can at once test either outside or inside, at pleasure, and can tap the line as he wishes, without disturbing the lightning-arrester strips or the fuse coils. The battery consists of ten storage cells placed in lead-lined tanks. The battery room is separated from the other rooms. The charging outfit consists of a direct-current, 240-volt motor coupled directly to a thirty-volt multipolar dynamo. The batteries have sufficient capacity to carry the switchboard during the time necessary to make any reasonable repairs to the charging outfit; hence, a duplicate charging equipment is not needed. Throughout the city the entire system of wires is placed underground. There are no party lines in use at the present time. The service is not measured, except so far as toll lines are concerned, a flat rate being made to the subscribers.—*Abstracted from the American Telephone Journal (New York), April* 8.

The Future of the Electric Automobile.

In dealing with the future of the electric automobile, says Mr. T. G. Chambers, it is impossible to foresee what developments may take place. The discovery of some new accumulator of small weight and great capacity, with phenomenal endurance, would alter existing conditions. It is far more probable that nothing of the kind will be found, and we shall continue to use the same materials that are possible to-day, with all their drawbacks. The elasticity of the electric motor and its ease of control, with silence and absence of odor and vibration, made the electric carriage very attractive at an early date. The inherent disadvantages of the dead load of accumulators and the necessary limit to the available supply of energy which could be carried were not so apparent in the days when automobiles of all descriptions ran at comparatively slow speeds, and when a day's journey of 100 miles without a hitch was a rare occurrence. The electric carriage, more than any other type of self-propelled vehicle, lends itself to the housing and manipulation of large numbers in a depot. The first electromobile garage was opened in London in 1901 by the City and Suburban Electric Carriage Company. The four years that have elapsed since that date have seen very rapid progress in similar directions, and to-day there are in London alone, under the auspices of various companies, six or seven large garages operating an aggregate number of between 400 and 500 electric carriages. The electric carriage is as nearly proof against mishap as any machine can be. Taking the last six months' work of the Electromobile Company's Curzon street garage, the total involuntary stops, excepting those due to power exhaustion, were sixty-one in 159,258 carriage miles. Of these stops, fourteen were due to a mechanical defect in the contact breaker, the possibility of which has since been entirely eliminated by an improved mechanism. Thirteen were due to the blowing of the main fuse, a matter immediately repairable by the driver. This leaves only twenty-five stops in about 160,000 carriage miles necessitating the attention of a mechanic, or, on an average, one stop in every 6,400 miles. When the limitations of the accumulators are understood and recognized, little or no difficulty arises from power exhaustion. With an effective range of from twenty-five to thirty-five miles upon one charge, and with the adoption of interchangeable batteries, a carriage may be run all day, if only time be allowed for its return to a depot to take up a new battery, an operation which takes from two to three minutes. Even with a garage in the most expensive and central position of London, the total costs per year are considerably less than they would be in the case of a horse-drawn vehicle giving a similar degree of luxury. When the electric carriage is used to its full extent, the costs are very considerably less. In certain individual cases, owners have effected an economy of as much as from £200 to £300 per year by exchanging their horse carriages for electric vehicles. In no case are they spending more than they did with their horses.—*Abstracted from the Electrical Review (London), March* 24.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Extensive Power Plant Equipments.

Swift & Company have ordered for their plant at Fort Worth, Tex., a 600-kilowatt, alternating-current, revolving-field, sixty-cycle Bullock generator—three-phase, 240-volt—with a normal of 120 revolutions per minute. This is for supplying both light and power. It will be furnished, together with an exciter, by Allis-Chalmers Company, from its electrical works at Cincinnati.

The Bethlehem Steel Company, of South Bethlehem, Pa., will install in one of its rolling mills at that place another heavy-duty, Reynolds-Corliss non-condensing engine, with cylinder thirty inches in diameter and a forty-eight-inch stroke, for direct-connection to a 500-kilowatt generator. The engine will be built at the West Allis, Milwaukee, works of Allis-Chalmers Company and is to be practically the duplicate of one now running at the South Bethlehem plant.

Mandel Brothers have let the contracts for a large power plant to be installed in the subbasement of their store building at 111-115 Wabash avenue, Chicago, Ill. This is to consist of engines and generators comprising five complete units, with an aggregate capacity of 1,500 kilowatts divided as follows: three of 400 kilowatts each, one of 200 kilowatts and one of 100. There will be three vertical, cross-compound, non-condensing engines, one horizontal engine of similar type and one horizontal single engine, all direct-connected to Bullock generators. The engines will be built by Allis-Chalmers Company at its West Allis, Milwaukee, works, and the generators are to be furnished by the electrical department, the Bullock Electric Manufacturing Company, of Cincinnati. The plant designed for Mandel Brothers is the result of careful study on the part of their consulting engineers, Adams & Schwab, and Holabird & Roche, the architects, and is believed to be especially well adapted to the purposes for which it is intended.

The Mineral Point Zinc Company, of Chicago, has ordered from the Allis-Chalmers Company the complete power equipment for its remodeled plant at Depue, Ill., consisting of two heavy-duty, cross-compound, Reynolds-Corliss engines, each with cylinders twenty-one and forty-two inches in diameter and a forty-eight-inch stroke; two 500-kilowatt Bullock generators, to which the engines will be direct-connected, one 100-kilowatt generator and twenty-four motors ranging in size from ten to seventy-five horse-power, with starters, rheostats, etc. The two power units are designed for operation at ninety revolutions per minute, the engines being especially constructed to meet that condition, but the smaller generator will develop a normal speed of 250 revolutions per minute.

Electricity in Industrial Applications.

A few years ago a great deal was being said about the application of electric motors for industrial service of every variety. At that time the gains being made by motor service in these applications were noteworthy and attracted considerable attention. This application has, however, become so universal that but little is heard now-a-days of the installation of small motors. Great as was the demand for small motors and separate driving units a few years ago, the call for this type of machine is very much greater today. Orders for hundreds of these motors, both alternating and direct current, are received every week by the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. An instance of this is to be found in the following contracts: the Alliance Machine Company and the Morgan Engineering Company, both of Alliance, Ohio, recently placed orders for a total of 120 crane motors with an aggregate of 2,000 horse-power. These motors vary in size from one horse-power to 100 horse-power. The Pennsylvania Railroad Company about the same time contracted for twenty induction motors to be added to its present motor equipment, and the Bethlehem Steel Company entered an order for direct-current motors to be used in its mills. Numerous smaller orders would make up a list of applications covering the whole field of motor-driven machines.

The Weiny-Phillips Repeaters.

Several changes have been made in the Weiny-Phillips repeaters, among them the adoption of the Barclay relay magnet. Mr. Walter P. Phillips is now having a plan worked out to simplify the instrument, in the expectation that the price will thus be materially reduced. This repeater is one of the most efficient in use.

Steel-Armored Cable Fittings.

The Sarco Company, 906 Sixth avenue, New York city, is meeting with great success in the sale and installation of Sarco steel-armored cable fittings. Fig. 1 shows the Sarco combined

FIG. 1.—COMBINED JUNCTION AND OUTLET BOX FOR STEEL-ARMORED CABLE.

outlet and junction box for steel-armored cable. The box is so constructed as to be readily available for several circuits. It is used with a duplex flat bushing. The box is made with a number of entrances, so that it can be made interchangeable, and will take from one to four cables. The holes which are

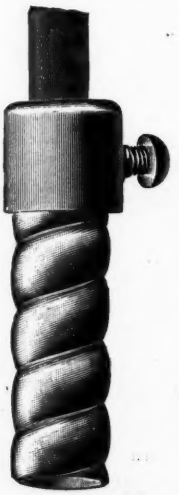


FIG. 2.—CABLE, WITH BUSHING IN POSITION.

not being used are sealed by means of slugs and flat spring clips. This outlet box is made in several different styles. The type A box is for electric service only; the type B box is for a combination of electric service and three-inch gas pipe; the type C box is for a combination of electric service and takes a one-half-inch gas pipe.

Fig. 2 shows a new form of cable bushing which the Sarco Company has recently placed on the market.

The "Metaphone."

The "Metaphone" is an interior telephone intended for use in offices, factories, hotels, clubs and residences. The apparatus consists of a transmitter and receiver mounted on opposite ends of a short metal handle. Fig. 1 shows a wall instrument consisting of a "Metaphone" suspended from a movable hanger in a small cylindrical box. This box is furnished in mahogany or black enamel. Upon the box is mounted a switch lever to connect with as many contact points as there are outlying stations. The "Metaphone" intercommunicating sets permit a number of stations to be so connected that from any one station direct telephonic communication to any other station can be automatically established, without the necessity of a central switchboard or switchboard operator. The connection in the present case is made by taking the "Metaphone" from the hook and moving the switch lever to the desired contact point. Pressing the button at the top of the instrument rings a bell at the connected station. Replacing the "Metaphone" upon the hook at the end of the conversation automatically restores the switch lever to its initial position.

FIG. 1.—WALL "METAPHONE."

Fig. 2 shows the new form of intercommunicating desk instrument. Each instrument is supplied with a number of stations, and the desired call is made by lifting the "Metaphone" from the cradle switch and moving the switch lever to the desired contact point. The connection is automatically broken by replacing the "Metaphone" on the cradle switch. If after talking to one station conversation with another is desired, it is unnecessary to replace the "Metaphone" on the cradle switch. The previously connected station is automatically cut out the instant the new connection is made.

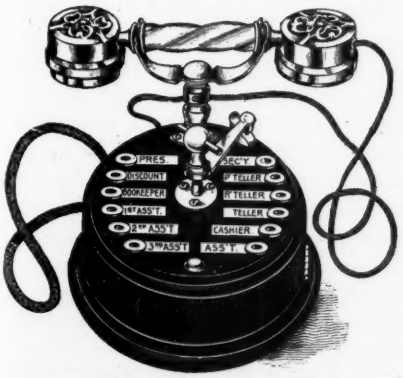


FIG. 2.—DESK "METAPHONE."

FIG. 3.—PUSH-BUTTON HOUSE "METAPHONE."

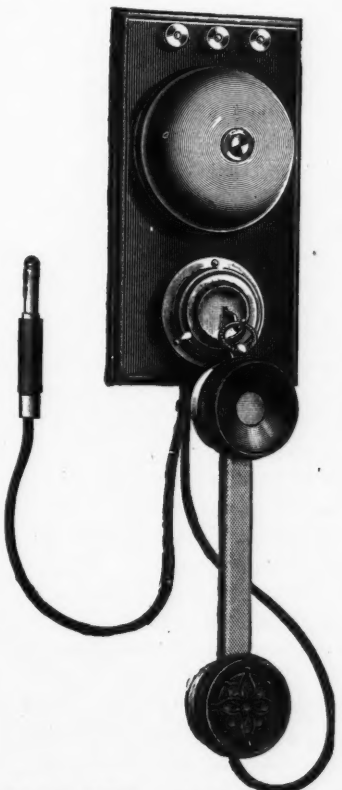


FIG. 4.—"METAPHONE" HOTEL CALL.

Fig. 3 shows a push-button house "Metaphone." This may be connected to an existing electric bell circuit without any alteration or additional battery.

Fig. 4 shows the instrument used with the "Metaphone" hotel system. This establishes telephonic communication between room and office, using the existing bell and annunciator installation. In each room a push-button "Metaphone" is connected to the existing bell wires and suspended by a clip hanger from the push-button. To telephone to the office, the guest pushes the button, takes the "Metaphone" from the hanger, places the upper end to the ear, and talks past (not into) the lower end. In the office a plug board is connected in series between the direct-room wires and the existing annunciator.

The "Innovate" Adjustable Hangers.

When the eyes are in a healthy, normal condition, they are strained and injured by employing artificial light that is stronger than shaded sunlight. It is said that any person who can not see perfectly well when close to a shaded ten-candle-power incandescent lamp requires glasses, but not increased candle-power. By bringing the lights used in any workshop down low over the work, and employing shade reflectors for eye protection and concentration of light, in many instances the quality of illumination for the work in hand is improved, and, at the same time, the cost of illumination is reduced.

Where suspended lamps are used, the employment of a thoroughly dependable automatic cord adjuster makes it possible to bring the lamps down low or push them up out of the way in a second. An automatic cord adjuster, made without weights or springs, and producing no wear on the lamp cord, may be relied upon if properly constructed. It should also be a device approved by the National Board of Fire Underwriters. The "Innovate" adjustable hangers, made by the Innovate Manufacturing Company, 145 Van Buren street, Chicago, Ill., are designed to meet these requirements. The manufacturer claims a saving of sixty per cent in illumination by using these hangers on all suspended lamp cords.

Starting-Compensators for Alternating-Current Motors.

A squirrel-cage induction motor of five horse-power, or over, causes an objectionably heavy rush of current if started by connecting directly to the line. Such sudden variations of line load may be obviated by installing a starting-compensator. That built by the General Electric Company consists of an inductive winding with taps, controlled by a switch so as to impress a reduced potential on the motor to bring it up to speed.

The accompanying illustrations show two forms of compensators for starting induction and synchronous motors which are now being produced at the Schenectady works. Fig. 1 shows a compensator of the "wall suspension" type, and Fig. 2 shows one of a type arranged to stand on the floor, for starting two-phase and three-phase induction motors. In each type the compensator consists of a core and windings, a terminal board and a switch, assembled in a cast-iron case, with an external operating handle. The cases may be opened for inspection of the interior, etc.

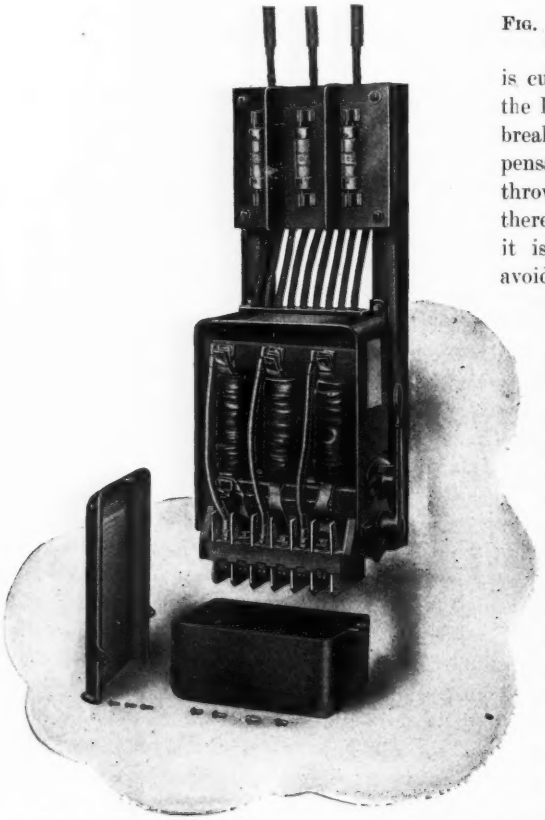


FIG. 1.—WALL TYPE COMPENSATOR FOR INDUCTION AND SYNCHRONOUS MOTORS.

The lever has three positions: "off," "starting" and "running." In the off position (Figs. 1 and 2) both compensator and motor windings are disconnected from the line. In the starting position the switch connects the line to the terminals, and the motor to the taps of the compensator winding, without breakers or fuses in circuit. In the running position the compensator winding

FIG. 2.—FLOOR TYPE COMPENSATOR FOR INDUCTION AND SYNCHRONOUS MOTORS.

is cut out and the motor is connected to the line through suitable fuses or circuit-breakers mounted directly above the compensator. To prevent the attendant from throwing the motor directly on the line, thereby causing a rush of current which it is the object of the compensator to avoid, an automatic latch is provided, so arranged that the lever at "off" can be thrown only into the "starting position" (backward), and can be thrown from thence into the "running position" (forward) only by a quick throw of the lever, whereby any appreciable drop in speed and consequent increase in current in passing from the starting into the running position is avoided. The compensators are designed to bring the motor up to approximately full speed within one minute after the switch has been thrown into the starting position.

For motors of high voltage or large capacity, the switching device is separate from the compensator itself. This arrangement gives an opportunity to start several motors in succession from a single compensator if desired, thereby saving the expense of a number of individual compensators. For starting large synchronous motors, a special equipment can be furnished consisting of a compensator provided with a large number of taps and a controller.

The Manufacture of Armington & Sims Engines.

The Marine Engine and Machine Company, with offices at 80 Broadway, New York city, and factories at Harrison, N. J., makes the following statement concerning the manufacture of Armington & Sims engines:

"We are pleased to announce to the engineering fraternity, steam users and the public generally, our purchase of all drawings, patterns, etc., of the later types of the well-known Armstrong & Sims high, medium and slow-speed engines, as improved and built during the last ten years.

"Mr. Gardiner C. Sims, under whose personal direction and supervision Armington & Sims engines were designed and have been built, has acquired an interest in our business and become its general manager. We are now engaged in building these engines under his personal direction and supervision, which affords ample guarantee that the always high-class character of materials and workmanship heretofore entering into the construction of Armington & Sims engines is carefully considered and fully maintained. From time to time we shall make such changes and improvements in the engines as may be found necessary to keep pace with the varying demands of the trade.

"We shall manufacture Armington & Sims engines as heretofore in sizes ranging from 10 to 3,000 horse-power, and in types horizontal and vertical, side and centre crank, single and in pairs, simple, tandem and cross-compound, triple and quadruple expansion, condensing and non-condensing, high, medium and slow speeds, with single and Corliss valves, and adapted to direct-connected, belted or other power-transmitting requirements.

"With our modern and roomy machine shops and foundries, both amply equipped with all necessary special tools and appliances for doing large and accurate work rapidly, we are in a position to make prompt deliveries of any of the sizes and types of engines we build.

"The undoubted merit and popularity of Armington & Sims engines seem fully attested by the fact that upward of six thousand six hundred of them have been built and sold in all parts of the world.

"We hope to hear from and earnestly solicit the cooperation of all present 'Armington & Sims' friends and customers, hoping to make new ones, and extend to them, as well as to intending purchasers, a cordial invitation to visit and inspect our works."

New Form of Hydraulic Governor.

The Lombard Governor Company, Ashland, Mass., has placed on the market a new type of hydraulic governor, especially adapted for present conditions in water-wheel service. The continual increase in the size of prime movers, in both steam and water-power plants, calls for new designs in governors to meet the conditions of increased efficiency and larger production. The necessity for improved accessory appliances is especially marked in water-power stations, where speed control of turbines is, at best, an exceedingly difficult problem.

The type N hydraulic governor is shown in the accompanying illustration. The construction is simple and massive. One large casting forms both the main cylinder and the bearings for the terminal shaft. The base forms the lower cylinder head. The upper cylinder head is integral with the cylinder. With this form of construction, maximum strength, with the least weight of metal, is obtained, while the possibility of the joints loosening under strain is eliminated. The straight cylinder construction with the piston motion along the axis is retained.

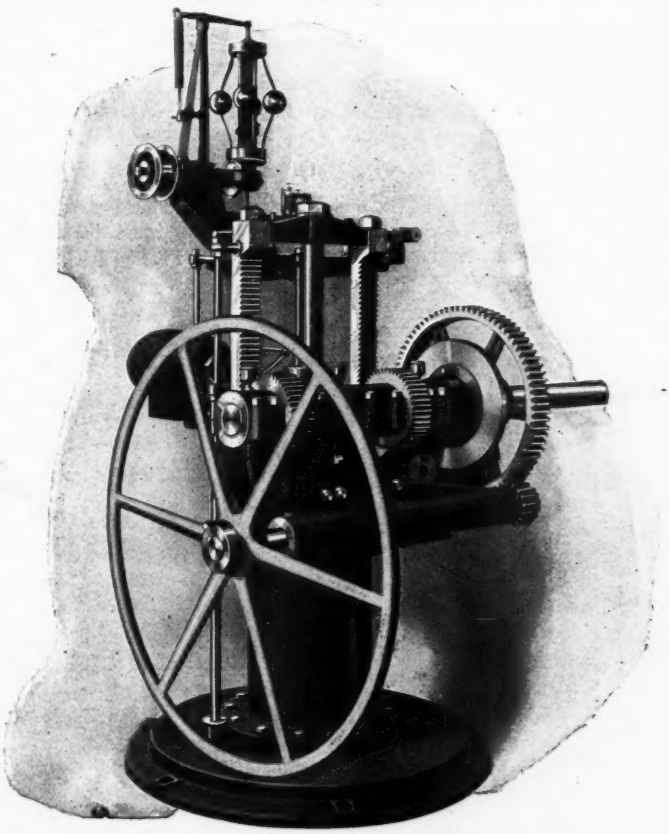
The linear motion of the piston is transformed in a simple manner by rack and pinion to a rotary motion at the terminal shaft. In order to reduce the vertical height of the governor, and also to transmit the great force at the piston to the rotating shaft in the most efficient manner, double racks and pinions are used, the racks being connected to an equalizing yoke. The location of the racks is alongside of the cylinder. The steel terminal shaft is two and fifteen-sixteenths inches in diameter, supported by bearings on both sides of the pinions. The total length of this shaft is twenty-six inches. The releasing clutch mechanism is of the well-known Lombard governor design, properly proportioned for the power of the machine. All keyways are extra wide. The terminal shaft pinions are not only keyed, but also shrunk on at a high temperature. The main piston-rod gland is cup-shaped, so as to prevent leakage. The usual form of hand wheel is employed. This is out of gear when the governor is in regular operation.

The working fluid for this governor is a special oil kept under pressure in a vertical drawn steel tank. Oil is forced into this tank by a powerful pump which is part of the equipment of the governor.

The especially novel feature of the type N governor is the relaying valve mechanism.

The main valve of the governor consists of a large double, hollow piston, contained in a horizontal cylindrical case back of the hand-wheel rim at the left of the illustration. The wearing surfaces of this valve are made of hardened steel, and the cylinder in which it travels has a hardened steel sleeve or bushing through which the ports are cut. The valve itself is balanced perfectly by its construction, so as to require comparatively slight force to move it. Reliance is not placed, however, on this fact, but powerful means are provided to ensure its movement. These means consist of hydraulic plungers supplied from the pressure system of the governor. These hydraulic plungers are under the simultaneous control of a very small primary valve attached to the stem of the centrifugal balls, and of a small valveless displacement pump in the slender vertical cylinder at the left of the illustration. The piston of this pump is attached to, and moves with, the main piston of the governor. The relation of these parts is such that the least displacement of the primary valve by the centrifugal balls causes an instantaneous and positive movement of the large main valve. The main valve is immediately restored to its closed position by the action of the displacement pump, as soon as the primary valve is again closed. There thus results an exact, immediate magnification by the main valve of the movement of the primary valve. This multiplication at the main valve of the minute motion of the primary valve, resulting from slight speed changes of the centrifugal balls, is the principal reason for the accurate speed regulation given by this type N governor.

In any hydraulic governor the least speed variation which will produce motion of the governor depends upon the lap of the valve controlled by the centrifugal weights—the smaller the lap, the greater the sensitiveness. On the other hand, slight lap of valve is conducive to large leakage and short life. With the relay valve form of construction used in the type N governor the lap of the main valve influences in no way the sensitiveness of the machine, and still ensures freedom from leakage. In order to take the utmost advantage of this valuable feature of its construction, the type N governor is provided with a primary valve having an outside micrometer adjustment for varying the amount of lap. By means of this adjustment it is easy to alter the sensitiveness of the governor while it is running, so that it will respond to speed changes of greater or smaller magnitude down to the limit where the governor is kept in motion by speed changes too small to detect. This micrometer adjustment is also a device to take up the loss of lap of the primary valve, due to wear. Sufficient adjustment is provided for many years of constant service.



NEW FORM OF HYDRAULIC GOVERNOR.

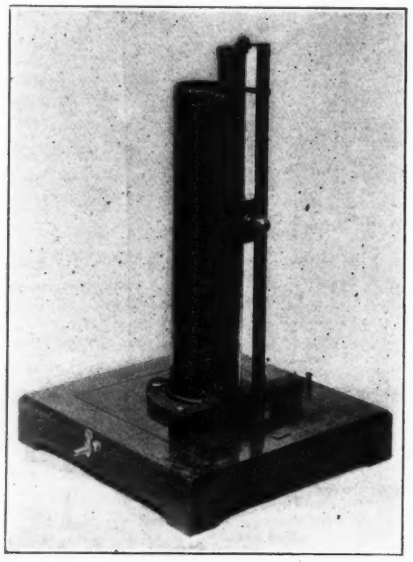
The anti-racing mechanism of the type N governor is of the well-known pattern used in the Lombard governors for many years. Certain improvements have been made in the nature of adjustment and in design, so that the effect in making the governor dead-beat is much more marked at the beginning of the stroke, when the water-wheel gates are just opening.

The type N governor is ten inches in diameter, with a twenty-four-inch stroke. Two hundred pounds pressure per square inch is the normal pressure, and the governor then expends 31,000 foot-pounds of energy per stroke. The factor of safety under this pressure is ample. Under emergencies the pressure has been increased over fifty per cent without harm to the governor.

Queen Stand-Pipe Rheostats.

Queen & Company, of Philadelphia, Pa., have recently designed a series of rheostats consisting of a continuous length of wire wound spirally on an iron stand-pipe, about six inches in diameter, of a length depending on the total resistance and the current-carrying capacity required.

The wire is insulated from the iron pipe to withstand an alternating potential of 1,000 volts. The pipe is closed at the bottom and by means of a small pipe, on either side of the base a stream of water can be introduced for cooling purposes. If the rheostats are not used at their maximum capacity, water is not necessary; when only used at their maximum capacity for a few minutes at a time the pipe filled with water, alone, is sufficient; running water is recommended, only when the rheostats will have hard continuous service at their maximum rated capacity.



STAND-PIPE RHEOSTAT.

The stand-pipe is mounted on a hardwood base, provided with castors, so as to be moved about the laboratory easily. Mounted parallel to the upright pipe is an angle iron guide, which carries a slider, to which are attached phosphor-bronze springs which, in turn, make contact against the wire on the pipe. All the parts are insulated except a rod in the centre of the angle iron guides, which is connected with the phosphor-bronze springs by means of a split brass sleeve in the wooden handle. This gives a very smooth even motion, and positive contact is made on every convolution of the wire, which allows adjustments of the current by almost infinitesimal steps.

These rheostats are highly recommended for laboratory work in electrolysis, where it is necessary to secure fine graduations of both current and potential. To secure a potential regulation, the rheostat is supplied with two sliders, the terminals of the main conductor are connected with the main current source of supply, and the wires to the apparatus are connected to the two sliders. By putting the sliders close together the difference of potential is very small, whereas by sliding them further apart it can be increased to any desired point.

These rheostats are made in several sizes; a special descriptive circular will be furnished by Queen & Company, on application.

A Simple Wire Shade-Holder

The Jem Shade-Holder Company, 13 East Thirtieth street, New York, has placed on the market a simple form of wire shade-holder, which is designed to be economical in construction, cheap in price, and very easy of application.

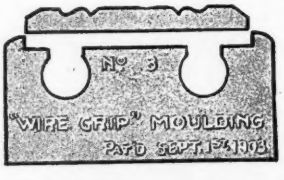
In applying this wire shade-holder, all that is necessary is to open the clasp

WIRE SHADE-HOLDER.

which confines the free ends of the wire clip, slip the prongs under the lip of the shade, push the shade with the holder attached over the socket as far as possible, press the free ends of the holder together, and fasten down with the clip. The manufacturer claims that the holder is absolutely rigid, and will not allow a shade to droop at any angle.

"Wire Grip" Moulding.

The accompanying illustration shows the new form of moulding made by the Improved Moulding Manufacturing Company, 26 North Seventh street, Philadel-



"WIRE GRIP" MOULDING.

phia, Pa. Wire grooves are so cut that the wire will not fall out of the moulding as it is being put in place, obviating the driving of tacks or staples to keep the wire in the run until the finishing board is put in place. The moulding is made of approved wood, and finished with a coat of fire and water-resisting paint. The moulding is also furnished in water-resisting oak, stained finish.

A "Wireless" Electric Battery.

The accompanying illustration shows an electrotherapeutic device manufactured by the Wireless Electric Company, 618 Chestnut street, Philadelphia, Pa. This battery is about nine and one-half inches in length, one and one-quarter inches in diameter, and weighs about twelve ounces.

"WIRELESS" ELECTRIC BATTERY.

The device is a compact cylinder made up of two highly polished tubes fitted over a wood core. One tube is fixed, and contains the charge, and the outer is movable, and is used to start, regulate and stop the electric current at the will of the operator. The wireless electric battery is the invention of Leon W. Pullen, Philadelphia, Pa.

Rock Drills on the Panama Canal.

The last official act of the Panama canal commission before resigning was to close a contract with the Ingersoll-Sergeant Drill Company, of New York, for fifty standard rock drills of that company's manufacture, complete with mountings and equipment. These machines are to be used in the removal of rock in the great Culebra cut through the crest of the isthmus. The commission furthermore authorized the same company to remodel a large number of the French-Ingersoll drills, built in France under the patents of the American manufacturers. These machines remain from the original equipment of the old French company formerly operating on the canal. This act of the commission is interesting as showing the intention of using American machines and American methods in this, the greatest undertaking in the history of rock excavation. While the fact that the old drills are still in a condition to justify their use shows the merit of machinery of American type and design.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

GERMAN WIRELESS TELEGRAPHY—The German government telegraph administration, of Berlin, announces the acceptance, at any office in Germany, of telegrams for transmission by wireless telegraphy to ships so equipped. Twenty cents per word will be charged, in addition to the rate of one and one-quarter cents for internal messages.

BRAZILIAN LIGHT AND TRACTION PROJECT—In the city of Rio de Janeiro, Brazil, there has been formed a company to install electric light plants and electric traction lines throughout the city. The city has hitherto been lighted by oil and gas, and the traction lines have been operated by mules. It is said that the General Electric Company, Schenectady, N. Y., has secured a contract amounting to about $4,000,000.

EXTENSION OF THE PARIS SUBWAY—It is announced that the present subway in Paris, France, is to be extended. The new line will be known as the Annexe Interieure. It will go from the Place de la Concorde, pass under the Rue Royale and follow the Grand Boulevarde to the Place de la Bastille. Thence it will pass under the Seine and return to the Place de la Concorde, *via* Boulevarde St. Germain and the Invalides railway station.

TO PURCHASE THE GAS, ELECTRIC LIGHT AND POWER INTERESTS OF SCRANTON, PA.—A project is said to be under way to purchase all of the water, light, heat, power and trolley companies in the city of Scranton, Pa., and vicinity. The American Electric Light Company for the past six years has been in control of the four leading electric light, heat and power companies: the Suburban Electric Light Company, the Scranton Illuminating, Heat and Power Company, the Scranton Electric Light Company and the Dunmore Electric Light Company. The water and gas companies are controlled by the Scranton Gas and Water Company. The water and gas companies are valued at $10,000,000, and the electric light companies are said to be worth at least as much more.

NEW POWER PLANT IN MAINE—It is announced that, within four months, work will begin on a large plant for the generation of electric power to be located at Bradley, on the Penobscot river, ten miles above Bangor, Me., or at Ellsworth, on Union river. It is planned to generate current on a large scale for use in the operation of manufacturing plants anywhere within a distance of twenty-five miles. The mills of the Eastern Manufacturing Company at South Brewer, near Bangor, will be the first to make use of the power. Several good water powers are available for the purpose, but the choice lies between Ellsworth and Bradley, and depends largely upon the cost of development and of adjacent lands. Mr. F. W. Ayer, president of the Eastern Manufacturing Company, is one of the principal parties interested in the scheme.

LARGE POWER PLANT AT TAYLOR'S FALLS, MINN.—The Minneapolis Electric Company and its controlling interests will spend some $3,500,000 in securing for Minneapolis and St. Paul, Minn., nearly double the present power available for manufacturing and other purposes. The power supplied at the present time by St. Anthony Falls is not sufficient to meet the demands for Minneapolis and adjacent cities. Recognizing this need the Minneapolis General Electric Company has secured a large water power right at Taylor's Falls. All of these privileges will be developed to the extent of 12,000 horse-power at once. This, however, can be doubled at any future time. The additional power will be transmitted at a pressure of 50,000 volts, and a substation will be located approximately on the dividing line between the twin cities. Power will be generated at Taylor's Falls station at 23,000 volts. This will be stepped up by transformers to 50,000 volts, which will be the transmission voltage.

ADDITIONAL POWER AT SAULT STE. MARIE, MICH.—The Edison-Sault Electric Company has let the contract for the construction of a new power-house in the Sault rapids to the McArthur Brothers Company. This is expected to be the first step in another large water-power development at the Sault. The new power-house will be entirely separate and independent of the present power plant, and will probably be constructed 350 feet further out into the stream. The intention is to leave ample room inside of the projected building for the construction of a pulp and paper mill which is eventually designed for that location. The extension, this far out into the rapids, will also necessitate the construction of new dykes in the river and a considerable amount of work above the site of the power-house itself. The building will be constructed entirely of cement. The present plans purpose the construction of a plant with a penstock capacity for six water-wheels, although at the outset but four will be installed. The water-wheels which will be used are expected to develop 720 horse-power each under full head. The structure above the penstocks will be one story in height, and will provide room for housing the dynamos. From the power-house current will be transmitted to the company's distributing station, which will be built during the present year on Arlington street, and distributed from there to all parts of the city as needed. Professor Gardner Williams, of the University of Michigan, will be the engineer in charge for the Edison company.

NEW COMPANIES.

WILMINGTON, DEL.—Becker Electrical Company. To manufacture electrical supplies. Capital, $1,500,000.

DETROIT, MICH.—The Arthur Dairs Electrical Construction Company has been incorporated. Capital, $1,000. Incorporators: Arthur Dairs, Agnes Dairs, James V. Oxtoby.

NEW YORK CITY, N. Y.—Torgal Trust Company. To manufacture electrical apparatus. Capital, $100,000. Incorporators: Charles W. Taylor, M. H. Mark, E. J. Ludvigs, all of New York.

ATLANTIC CITY, N. J.—Atlantic City Suburban Electric Company, electrician. Capital, $100,000. Incorporators: Louis Kuenle, John C. Reed, Atlantic City; H. E. Woodman, Philadelphia.

SPRINGFIELD, ILL.—The Benard Economical Arc Light Company, of Chicago, has been organized with a capital of $15,000. The incorporators are Jeremiah J. O'Donohue, Peter F. Daly and William J. Moore.

CINCINNATI, OHIO—The Electric Speed Meter Company has been incorporated with a capital of $30,000. To manufacture electric meters. The incorporators are W. H. Whitstone, Martin J. Hester, J. C. Short, R. C. Anderson and J. M. Hatton.

SPRINGFIELD, MASS.—The Fretts Electric Switch Company has been incorporated to deal in electrical appliances. The capital stock is $50,000, and the officers are: president, Herbert L. Handy; treasurer, Sayward Galbraith, both of Springfield.

BANGOR, ME.—The Massachusetts Car Fender Company has been organized at Portland for the purpose of manufacturing and dealing in all kinds of car fenders, car guards, etc., with $125,000 capital stock. The officers are: president, Ardon W. Coombs, of Portland; treasurer, Charles H. Tolmon, of Portland.

JERSEY CITY, N. J.—The Electric Composition Company has filed articles of incorporation with the county clerk. The company will manufacture type-making machinery under special patents. The capital stock is fixed at $1,000,000, and the incorporators are John H. Keppleman, Gilbert H. Montague, Ross A. Mackey, H. Scoville and John J. Treacy.

PROVIDENCE, R. I.—Articles of association have been filed with the secretary of state by Herbert B. Rust, Thomas Beswick and William C. Halstead for the H. B. Rust Company, for the purpose of engaging in the business of electrical contracting, engineering, constructing and dealing in electrical and other supplies. The capital stock is $50,000, and the concern will have headquarters in Providence.

TELEPHONE AND TELEGRAPH.

MANSON, IOWA—The Central Telephone Company's system in Manson is being reconstructed.

DOVER, TENN.—The Farmers and Merchants' Telephone Company has completed its lines to Dover.

MONROE, WASH.—The Sunset Telephone Company is rebuilding its line between Monroe and Machias.

PANA, ILL.—The Pana Telephone Company has voted to increase its capital stock from $15,000 to $30,000.

ATHENS, ALA.—A new telephone line, covering twenty miles of territory in the southwestern part of Limestone County, is being built.

BUFFALO, N. Y.—The Bolivar Telephone Company has increased its capital stock from $2,750 to $15,000, and will extend its lines into new territory.

FARGO, N. D.—The Tri-State Telephone Company has secured the right of way for the construction of a long-distance line through the city of Fargo.

ORANGE, TEX.—The Orange-Newton Telegraph and Telephone Company has made connection from its office at Orange with Fields, La., Stark and Niblett's Bluff.

NEW ORLEANS, LA.—A site has been purchased by the Cumberland Telephone and Telegraph Company for the establishment of a second branch exchange.

ATLANTIC CITY, N. J.—The Delaware & Atlantic Telephone Company's plans for the extension of its conduit system have been approved by the city council of Atlantic City.

COLUMBUS, OHIO—The Jackson County Home Telephone Company, an independent concern, has passed into Bell control for about $150,000. The company controls lines in Jackson, Wellston, Coalton, Oak Hill and Hamden.

LINCOLN, ILL.—Construction work will soon commence for the installation of a complete telephone service in Menard County by the Interstate Telephone Company. The company expects to build lines to Petersburg, Athens and Tallula.

LEBANON, IND.—With the exception of the Thorntown Cooperative, all of the independent telephone companies in Boone County have formed themselves into an organization to be known as the Protective Telephone Association of Boone County.

BRISTOL, S. D.—An independent telephone line is being constructed by the farmers living east and south of Bristol. The line has been extended already to the homes of a large number of farmers. When the line is completed steps will be taken to extend it into Bristol.

CHILI STATION, N. Y.—An agent of the Home Telephone Company, of Rochester, has been securing the right of way for a line through the south and central part of Chili, which will develop a large farming district. The right of way has been granted, and work will begin immediately.

SIOUX CITY, IOWA—The new building of the Sioux City Telephone Company on Jones street, Sioux City, has been completed. The building is of brick, and has two stories and a basement. The switchboards will have a capacity of 2,000 instruments. The automatic system has been adopted.

MAGNOLIA, MISS.—Local capitalists and others, whose business interests will be promoted, are endeavoring to form a company to construct a telephone line from Magnolia to Tylertown. The distance is twenty-one miles, and telephone interests would greatly facilitate the business interests of both places.

CANANDAIGUA, N. Y.—The Bell Telephone Company announces that it expects to expend $250,000 in extending and improving its services throughout the division which includes Canandaigua. A line is to be run from Canandaigua to Rushville, and through the Middlesex valley. Other extensions are contemplated.

BEALLSVILLE, PA.—The Beallsville Telephone Company has been organized by residents of West Pike Run township with the following officers: president, W. H. Wilson; secretary, F. L. Weaver; treasurer, E. Deems. Nearly all the farmers in the southeastern section of the county have taken stock.

TERRA HAUTE, IND.—The board of county commissioners has granted a franchise to the Farmers and Merchants' Telephone Company, conveying the right to build and maintain a telephone line through Sugar Creek and Fayette townships. A franchise had already been procured for a passage through West Terra Haute.

RENSSELAER, N. Y.—The Hudson River Telephone Company has purchased a site upon which it will construct a modern telephone exchange. The new building, for which plans and specifications have been drawn, will be a two-story brick, fireproof structure, and is to have a frontage of forty feet and a depth of thirty feet.

OMAHA, NEB.—The citizens of Council Bluffs have voted to grant a franchise to the Independent Telephone Company. The plans of the company provide for the raising of $100,000. The first step will be the construction of toll lines to Missouri Valley, Pacific Junction and through the county in the direction of Des Moines, to connect with all the independent lines.

RIVERSIDE, CAL.—The Southwest Home Telephone Company has been granted permission to extend its lines to San Jacinto, Perris and the Perris Valley country. The request was granted with the understanding that within one year the telephone company is to expend $15,000 in improvements, and another $5,000 before the end of the third year.

SULPHUR SPRINGS, COL.—The Colorado Telephone Company contemplates letting contracts for new copper wire lines from Sulphur Springs, across the Gore range to Steamboat Springs and other Routt County points, also stringing extra wires to Denver *via* Georgetown. The rapid growth of the country and increasing business make these improvements necessary.

BRISTOL, TENN.—The American Long-Distance Telephone Company is making preparations to extend its long-distance lines from Lynchburg, Va., to Knoxville, Tenn., *via* Bristol, which will give it direct connection with southwest Virginia and east Tennessee, a territory that is now being rapidly developed. It is stated that the work will be commenced this spring, with a view to having it completed by next fall.

MARYSVILLE, CAL.—The Bear River Telephone Company has been organized at Wheatland. E. T. Manwell is president and A. C. Stagner secretary. The company has a barbed wire telephone system in the southern part of Yuba County and in Sutter County. The line connects a large number of farms and several towns. It is now proposed to complete the system between Sacramento and Marysville.

SALT LAKE CITY, UTAH—Superintendent H. H. Hempstead, of the Rocky Mountain Bell Telephone Company, states that a new line will be constructed from Bancroft to Soda Springs, Ida., and another line will be started at Minidoka, which will follow the line of the new railroad being built by the Oregon Short Line. Eventually this line will penetrate all parts of the valley to be irrigated by the Twin Falls canal, including the new Twin Falls City.

LAFAYETTE, GA.—The Walker County Telephone Company has finished its new line as far as Menlo, and work is being pushed to finish the entire line, which, when completed, will extend to Menlo, Liberty and Ringgold. This company has changed hands recently, and work has been begun to make this one of the best lines in Georgia. The following are the new officers: W. S. Witham, president; R. M. W. Glenn, general manager; S. A. Hunt, Jr., secretary and treasurer.

FORT WAYNE, IND.—The annual meeting of the National Telephone and Telegraph Company was held recently, when the board of directors was reelected as follows: H. C. Paul, C. S. Bash, G. Max Hofmann, W. L. Moellering, William Bohn, August E. C. Becker, E. M. Popp, Sam S. Fisher and James McKay. Officers were then elected as follows: president, H. C. Paul; vice-president, C. S. Bash; secretary, W. L. Moellering; treasurer, William Bohn. The annual report showed a great increase of business, and the officers were authorized to expend $15,000 the coming year in improvements. Much of this money will be used to put in heavier wires for the long-distance business. The company now has connections with Cleveland, Toledo, Indianapolis, Louisville and many Michigan points, and expects to extend its connections the com-

ing year into Chicago, Pittsburg and Philadelphia. There will also be extensions made for connections with St. Louis.

COLUMBUS, GA.—The Southern Bell Telephone Company has bought the Adams telephone lines in Georgia and Alabama, and will begin the erection of a line from Columbus to Omaha, Ga., the headquarters of the Adams system.

TAYLORSVILLE, KY.—E. B. Stratton, manager of the Cumberland telephone exchanges at Taylorsville and Bloomfield, has secured the requisite number of subscribers at Chaplin, and the company will install an exchange at that place at once.

DOYLESTOWN, PA.—Linemen of the Bell Telephone Company are at work building a line from Buckingham to Wycombe and Pineville. The exchange will be at Wycombe. During the summer an exchange will also be installed at Plumsteadville.

ROCHESTER, N. Y.—Through the efforts of J. George Kaelber, president of the Rochester Electrical Signal Company, that corporation has been merged with the American District Telegraph Company, which will combine the former company's system with its own signal system. The Rochester company, formerly known as the Standard Electric Signal Company, has fire-alarm signal boxes in many residences and buildings. The American District Telegraph Company, which is practically the Western Union Telegraph Company, has a system consisting of messenger and police calls and registering of watchmen.

PITTSBURG, PA.—All preparations have been completed by the management of the Pittsburg & Lake Erie Railroad for the completion of the final work on the new long-distance telephone line which will extend from Pittsburg to Youngstown (sixty-eight miles), and which will connect there with the telephone system of the Lake Shore, giving the Pittsburg officials a through line to Chicago and New York, by which all important offices of the Vanderbilt system can be reached directly by private wire. The private long-distance wire will be connected with the Lake Erie private exchange in the South Side terminal building, and with the Lake Shore private exchange at Youngstown.

EDUCATIONAL.

VIEWS OF THE MICHIGAN COLLEGE OF MINES—The Michigan College of Mines, Houghton, Mich., has issued a book of views which is supplemental to the catalogue descriptions and reports of the work at the college. The views include the various buildings, interiors of laboratories, photographs of squads of students on field work, and a picture of the college glee club for 1904.

THE WASHINGTON AGRICULTURAL COLLEGE AND SCHOOL OF SCIENCE, of Pullman, Wash., announces that the recent act of legislation changed the name of the institution to the State College of Washington. Liberal appropriations were made for increased equipment in the mechanical and electrical department, and large additions are being planned for the electrical laboratories.

SUMMER SCHOOL FOR ARTISANS—The University of Wisconsin will conduct a summer school for artisans, under the direction of the College of Engineering, beginning June 26 and ending August 4. The courses will cover engines and boilers, applied electricity, mechanical drawing and machine design, materials of construction, fuel and lubricants, shop work and manual training. The requirements for admission do not extend beyond a working knowledge of English and arithmetic.

UNIVERSITY OF MINNESOTA—On Friday afternoon, March 17, Mr. Charles E. Downton, of Pittsburg, gave a very interesting lecture before the engineering students of the University of Minnesota, describing the works of the Westinghouse Electric and Manufacturing Company. With the aid of a moving-picture machine he took his audience from the Union depot in Pittsburg, along the Pennsylvania railway, past the various factories of the Westinghouse companies, thence through several shops of the electric factory, showing numerous steps in the construction and testing of electrical machinery. Of particular interest were several series of views showing heavy work in progress in the forge shop and foundry. The audience was much impressed by the magnitude of the works and by the long lines of employés leaving the factory and taking the trains, some twelve thousand employés being engaged.

THE ENGINEER AND HIS EDUCATION—"The Engineer and His Education" is the title of a brochure by Professor William Kent, dean of the Lyman C. Smith College of Applied Science, Syracuse University. Professor Kent differentiates the calling of the civil engineer, the mechanical engineer and the electrical engineer. He combines the complete engineer, however, with all three of these professions. A well educated and experienced engineer, he says, is not a skilled workman or artisan, but he is a man who knows how the artisan should do his work. He draws attention to the essential conditions to which the young man must adapt himself upon entering his course in engineering. The prospects of the engineering profession are pointed out. The great prizes are only for the few. A comfortable maintenance is for the majority, and the failures are no greater in number than in other professions.

PURDUE UNIVERSITY CATALOGUE—The 1904-1905 catalogue of Purdue University has been received. The number of students in attendance during the year 1904-1905 was 1,528, representing thirty-six states of the Union and ten foreign countries. Of the total enrolment, 410 were students of electrical engineering. The freshman class—by far the largest in the history of the university—numbered 461 students, the sophomore class, 389 students; the junior class, 261 students, and the senior class, 203 students; postgraduates, twenty-eight; students of pharmacy and special students, eighty-one. The number of graduates in electrical engineering in June, 1904, was fifty-six, and the number of electrical engineers to be graduated in June of this year will be sixty-five. The university offers courses in electrical, mechanical and civil engineering, science, agriculture and pharmacy. The number of professors, instructors and assistants in the faculty last year was 109.

NEW PUBLICATIONS.

"DEVELOPMENT OF THE LAKE SUPERIOR COPPER MINES DURING 1904"—This is the title of a book brought out by Arthur L. Carnahan, mining editor of the *Daily Mining Gazette*, Houghton, Mich. The book is 6 by 10 inches, bound in paper, and sells for fifty cents. It treats of the improvements made in the various mines during the past year.

"ELECTRIFICATION OF THE LONDON UNDERGROUND ELECTRIC RAILWAYS COMPANY'S SYSTEM"—This is a reprint of an article by Mr. S. B. Fortenbaugh, which appeared under the above title in the *Street Railway Journal*. It describes the Chelsea generating station and substations, the tunnel lighting and signal apparatus, the telephone system, the timekeeping system, the cars, and other electrical equipment of the system.

PROGRESS IN ELECTROCHEMISTRY IN THE UNITED STATES SINCE 1900—A bulletin entitled "Progress in Electrochemistry in the United States Since 1900," by Charles A. Doremus, New York city, has been reprinted from the report of the Fifth International Congress of Applied Electrochemistry, Berlin, 1903. This publication is a particularly valuable index of the development of electrochemical research in recent years. The materials touched upon are numerous, and embrace practically everything that has been attempted in electrometallurgical and electrochemical reduction. Several illustrations are given, showing forms of apparatus used for the fixation of nitrogen from the atmosphere.

THE CLARKSON BULLETIN—The Clarkson bulletin for January, issued by the Thomas S. Clarkson Memorial School of Technology, Potsdam, N. Y., has been received. The contents of this number are as follows: "The Science and Practice of Civil Engineering," Founder's Day address, by William Sooy Smith. "A Modified Westphal Balance for Solids and Liquids," by F. M. Williams. Abstracts of graduating theses presented for baccalaureate degrees, June 17, 1904, as follows: "Micrographic Examination of Steel Construction of Apparatus Used," Samuel Fitch Carlisle; "Discharge of the Raquette River at Potsdam, N. Y.," Charles A. Gridley and Ralph D. Hayes; "An Investigation of the Waste Liquor of the Sulphite Pulp Process," Frank Casper Zapf; "Vegetarian Dietaries," Bessie E. Andrews and Anna L. Smith. An index of the Clarkson Alumni Association, with notes on the student organizations, and a sketch of the Clarkson summer school, are given.

NEW INCORPORATIONS.

McCONNELSVILLE, OHIO—Home Telephone Company. $25,000.

DETROIT, MICH.—Davis Electric Construction Company. $1,000.

DES MOINES, IOWA—Dayton Telephone Company. Increased to $25,000.

MONTREAL, QUEBEC—The Richelieu Light and Power Company. $500,000.

NASHVILLE, TENN.—Southwestern Dixie Telephone Company, of Carroll County. $1,000.

BORDEN, IND.—The Farmers' Union Telephone Company. $1,000. J. G. Scott, president.

NEW LONDON, IOWA—Henry County Telephone Company. Increased from $15,000 to $30,000.

CHICAGO, ILL.—The Chicago, Kankakee & Champaign Electric Railroad Company. $100,000.

DYSART, IOWA—Geneseo Mutual Farmers' Telephone Company. $2,000. L. R. McElhinney and others.

PIERRE, S. D.—Farmers' Epiphany Line. $1,750. Incorporators: Henry Roth, Theodore Roster and others.

DOVER, DEL.—American Telephone and Telegraph Company. To operate telephone and telegraph lines. $50,000.

SANFORD, ILL.—The Sanford Mutual Telephone Company. $5,000. Incorporators: C. A. Ray, W. Smith, J. M. Art.

FARNHAMVILLE, IOWA—Farnhamville Mutual Telephone Company. $10,000. Incorporators: Charles Rose and others.

BONDVILLE, ILL.—Bondville Telephone Company. $2,500. Incorporators: William H. Scott, George A. Keller, Otis W. Norton.

MANITOWOC, WIS.—Fox River Valley Railway Company. $25,000. Incorporators: Henry Byersdorf, Fred Byersdorf, L. H. Bazien.

DOVER, DEL.—Central Light and Traction Company. To construct and dispose of plants for lighting, heating and power. $1,000,000.

ALBANY, N. Y.—Bennington Electric Company. $125,000. Incorporators: A. H. Beckman, W. D. Eaton, G. D. Martin, all of New York city.

CHICAGO, ILL.—Brennan Electric Construction Company. $5,000. Incorporators: William F. Brennan, Joseph P. Early, Daniel F. Cleary.

ALEXANDRIA, VA.—Opequon Telephone Company. $1,000. Officers: president, C. W. Snapp; vice-president, H. T. Snapp; secretary, E. J. Snapp.

WOODBURY, N. J.—The Gloucester County Electric Company. $50,000. Incorporators: Enos R. Artman, Manasses K. Treichler, Edward F. Johnson.

LITTLETON, ILL.—Schuyler County Central Mutual Telephone Company. $1,200. Incorporators: George Leonard, W. C. Chipman and W. H. Kettering.

MONROE, N. Y.—The Grange & Rockland Electric Company. $50,000. Directors: Zael Paddleford and Luther Terwilliger, Monroe; G. M. Roe, Chester.

WINCHESTER, VA.—Frederick & Clarke Telephone Company. $5,000. Charles Mullikin, president; H. F. Byrd, vice-president; Shirley Carter, secretary.

MUNCIE, IND.—Citizens' Electric Light Company. $200,000. Directors: Charles E. Hinkley, H. J. Keller, W. C. Braun, C. Roy Hathaway and William F. Warner.

NEW WINCHESTER, IND.—The New Winchester Farmers' Mutual Telephone Company. $1,000. Incorporators: Henry Beckley, Francis Sheets, Harvey Hays, Jr.

LOS ANGELES, CAL.—Redonia Home Telephone Company. $40,000. Directors: C. F. Guthridge, C. L. Zahn, D. F. Boyce, C. P. Platt and A. Wright, all of Los Angeles.

RALEIGH, N. C.—Wilmington & Southport Telephone and Telegraph Company. $5,000. Incorporators: D. I. Watson, L. J. Pepper, Richard Dosher, W. B. Cooper and S. F. Craig.

NASHVILLE, TENN.—Tennessee Power Company. $100,000. Incorporators: C. H. Ackerman, W. B. Dinsmore, Jr., F. F. Culver, C. H. Hart, T. M. R. Meikleham, Granville Whittlesey.

ASHTABULA, OHIO—Wayne Telephone Company. $6,000. Incorporators: S. A. Babcock, R. P. Miner, A. C. Bogue, D. L. Ketcham, William Dolan, R. Dillon and O. H. Ketcham.

HOOPESTON, ILL.—Interstate Traction Company. $100,000. Incorporators: James H. Dyer, James A. Cunningham, A. H. Trego, Charles C. Williams and J. S. McFerren, all of Hoopeston, Ill.

ALTUS, O. T.—The Altus Light, Power and Ice Company. $25,000. Incorporators: A. Reumelli, of St. Louis, Mo.; Henry Braun, of Guthrie; D. R. Rankin, H. H. Lloyd and E. W. Newell, of Altus.

CHICAGO, ILL.—Morris Terminal Railway Company. $50,000. Incorporators: Charles E. Hook and Oscar Harberle, of Ottawa, Ill.; Edward C. Curtis, of Grant, Ill., and George T. Buckingham, of Danville.

WERNERSVILLE, PA.—The Wernersville Light, Heat and Power Company. To supply light to the borough of Wernersville. $5,000. Incorporators: George W. Wertz, Robert W. Wertz and David Froelich.

SALT LAKE CITY, UTAH—Fairview Electric Light and Power Company. $15,000. Peter Olson, president; A. V. Miner, vice-president; Peter Sundwall, secretary and treasurer, all of Fairview, Sanpete County.

DAYTON, OHIO—Dayton & Northern Railroad Company. To construct an electric line from Dayton to Kenton. $100,000. Incorporators: M. W. Chambers, F. H. James, Webster W. Shuey, Hugo Cook and John J. Hall.

HELENA, MONT.—Madison River Power Company. $600,000. Directors: Pressley E. Bisland, Bronxville, N. Y.; Allen J. Nichols, Charles R. Ganter and Albert S. Ridley, New York city, and William S. Brayton, East Orange, N. J.

GULFPORT, MISS.—The West Gulfport & Race Track Street Railway Company. $25,000. Incorporators: Phil A. Dolan, J. R. Hill, J. R. Pratt, S. P. Moorman, E. S. Burrill, W. R. Batchellor, J. T. Richardson and P. H. M. Tippin.

HARTFORD CITY, IND.—Indiana, Hartford City & Eastern Traction Company. $25,000. Directors: Charles G. Buell, Alfred M. Weeden, Robert G. Kirkpatrick, Thomas F. Colbert, William R. Garver, John Feiger and Frank L. Scott.

PORTLAND, ME.—Cascade Light and Power Company. To manufacture and deal in electricity and gas for heat, light and motive power. $100,000. Officers: president, C. A. Hight, of Boston, Mass.; treasurer, L. L. Hight, of Portland.

RICHMOND, VA.—The Lincoln Telephone Company. To construct, maintain and operate a telephone line in the county of Loudoun, and to do a general telephone business. $5,000. Officers: W. T. Smith, Lincoln, president; H. T. Pancoast, secretary and treasurer.

ATLANTIC CITY, N. J.—The Atlantic City Suburban Electric Company. The company is to do a general electric business, to manufacture and deal in electrical heat and light and power. $100,000. Incorporators: Louis Keuhnle, Harry E. Woodman and John C. Reed.

CLINTON, N. Y.—Clinton Home Telephone Company. To operate in Clinton, Kirkland and Clark's Mills in Oneida and Madison counties. $25,000. Directors: C. D. Hayes, G. T. Caldwell, H. S. Powell, M. S. Powell, all of Clinton; C. H. Poole and T. H. Ferris, of Utica, and G. R. Fuller, of Rochester.

OTTAWA, ONTARIO—The Grand Falls Power Company. $200,000. Incorporators: Sir William C. Van Horne, of Montreal, Redfield Proctor, of Proctor, Vt.; Richard B. Angus, of Montreal; Hugh Havelock MacLean, of St. John, New Brunswick; Frank C. Partridge, Proctor, Vt.; Frank Ray Kimberley, of New York, and Ernest Alexander, of Montreal.

ALBANY, N. Y.—The Savannah Telephone Company, of Savannah, Wayne County. To construct lines connecting Savannah, Clyde, Port Byron, Wolcott, Red Creek, Seneca Falls, Cato and other points in Wayne, Cayuga and Seneca counties. $4,000. Directors: Charles A. Mead, Crossman A. Coleman, Fred W. Hadden and Edson S. Wood, of Savannah; Marcus S. Fowler, of Butler, and George P. Vandewater, of Spring Lake.

PERSONAL MENTION.

MR. R. S. WHEELER has resigned his position as manager of the Cumberland Telephone and Telegraph Company's office at Paris, Tenn., and has taken charge of a crew on construction work for the company.

MR. RICHARD DEVENS, who has for some years been connected with the European office of the Brown Hoisting Machinery Company, Cleveland, Ohio, has been appointed manager of the company's New York office at 26 Cortlandt street, to succeed Mr. W. A. Stadelman who has resigned.

MR. GEORGE CUTTER, whose name has been connected with Chicago ever since the early days of electric lighting, has moved to an entirely new location. The finishing touches are now being put on his new factory at South Bend, Ind., where the George Cutter Company will be located after April 15.

MR. WALTER I. BARNES has been appointed assistant general manager of the Narragansett Electric Lighting Company, Providence, R. I. He succeeds Mr. Arthur B. Lisle, resigned. Mr. Barnes has been with the company for thirteen years, the first part of the time being in the treasurer's office. For the past six years he has held the position of general superintendent.

MR. ARTHUR B. LISLE, well known in electric lighting circles of New England, and for years associated with the Narragansett Electric Lighting Company, has entered the banking business, becoming a member of the firm of D. A. Pierce & Company, Providence, R. I. This company is a leading banking and brokerage house of Rhode Island, and Mr. Lisle's association with it will undoubtedly be of mutual advantage.

MR. LOUIS B. MARKS has associated with Mr. Henry Floy in consulting engineering work, with offices at No. 220 Broadway, New York city. Mr. Marks will make a specialty of illuminating engineering, in which field he has had great experience, and which he believes will offer large opportunity for new work. He has been appointed illuminating engineer for the new buildings of the College of the City of New York, which are now being erected on St. Nicholas terrace. The architects are Messrs. George B. Post & Sons.

MR. L. G. RICHARDSON, president of the Central Union Telephone Company, has been elected president of the Cleveland Telephone Company, the local Bell exchange at Cleveland, Ohio. The Central Union company embraces the Bell exchanges in Ohio other than Cleveland, and in Indiana and Illinois. President Richardson will be able to devote much of his time to the development of the Cleveland company, and is said to be thoroughly in sympathy with an aggressive campaign which the local Bell people have begun.

MR. T. T. LYMAN has been appointed general sales manager of the H. W. Johns-Manville Company, of 100 William street, New York city. The position will call for the installation of various comprehensive systems in connection with the work of its branches in Milwaukee, Chicago, St. Louis, Boston, Philadelphia, Pittsburg, Cleveland, New Orleans and San Francisco, enabling the company to keep pace with the growth of the business in its territory, and will contemplate the opening up of new territory as the interests of the company may require.

MR. W. E. BELLMAN has been appointed manager of offices for the ninety branches of the Western Union Telegraph Company in St. Louis, Mo. Mr. Bellman began as telegraph operator twenty years ago, and has been employed in every branch of railway, commercial and newspaper telegraph work. He was appointed chief operator at Cedar Rapids, Iowa, in 1889, and resigned a year later to enter the brokerage business. He worked first as an operator at Kansas City, and later became manager of a broker's office in Chicago. He was with the Wabash Railroad from 1893 to 1898 as manager of a railway office, and was later train despatcher, and lastly, chief clerk and superintendent of telegraphs. Since that time he has been with the Western Union company, holding positions as operator, division chief, traffic chief and solicitor. During the St. Louis World's Fair he was manager of the Western Union branch on the exposition grounds.

ELECTRICAL SECURITIES.

Apparently a strong upward tendency has been developed during the past week. The feeling of apprehension which accompanied the reaction of two weeks ago has entirely disappeared, and prices in many cases are again at the high levels quoted just before the break. From every quarter comes news of returning confidence and enthusiasm. A period of beneficent weather conditions would do much to keep this enthusiasm kindled, and make ready for a real boom in all directions. Railroad earnings are more favorable, and the iron and steel industry appears decidedly busy and prosperous.

ELECTRICAL SECURITIES FOR THE WEEK ENDING APRIL 8.

New York:	*Closing.*
Brooklyn Rapid Transit	69⅞
Consolidated Gas	205⅝
General Electric	188½
Interborough Rapid Transit	209
Kings County Electric	200
Manhattan Elevated	166½
Metropolitan Street Railway	122¾
New York & New Jersey Telephone	171
Westinghouse Manufacturing Company	196⅞

The Brooklyn Rapid Transit Company has applied to the New York Stock Exchange to list $1,750,000 additional refunding mortgage 4 per cent bonds of 2002.

Boston:	*Closing.*
American Telephone and Telegraph	144⅞
Edison Electric Illuminating	256
Massachusetts Electric	68
New England Telephone	139
Western Telephone and Telegraph preferred	101

The New England Telephone and Telegraph Company has filed its statement of financial condition with the Massachusetts secretary of state as of date December 31, 1904, as follows: assets—real estate, $702,561; cash and debts receivable, $3,827,201; merchandise, $1,284,554; plant and franchise, $24,815,829; miscellaneous, $1,132,567, a total of $31,762,713. Liabilities—capital stock, $23,180,000; debts, $5,265,064; reserve, $1,720,245. This makes the surplus for the year $1,597,403. The directors of the company have declared the regular quarterly dividend of 1½ per cent, payable May 15 to stock of record April 20.

The railroad commission has authorized the Boston Elevated to issue $7,500,000 4 per cent, thirty-year bonds.

Philadelphia:	*Closing.*
Electric Company of America	12⅛
Electric Storage Battery common	86½
Electric Storage Battery preferred	86½
Philadelphia Electric	11¼
Philadelphia Rapid Transit	31¼
United Gas Improvement	115¾

Chicago:	*Closing.*
Chicago Telephone	142
Chicago Edison Light	165
Metropolitan Elevated preferred	61
National Carbon common	52
National Carbon preferred	115
Union Traction common	9½
United Gas Improvement	40

The Chicago Telephone Company reports a gain of 1,919 new telephones during March. The total number now in use is 123,284.

The Metropolitan West Side Elevated Railroad Company has issued its report for the year ended February 28, 1905. The income account is as follows: gross, $2,160,941; expenses, $1,059,107, leaving net of $1,101,834; charges, $860,409, making the surplus for the year $241,425, as compared with $216,107 for 1904. The report shows about 2¾ per cent earned on the preferred stock. The daily average of passengers was 114,232, and the percentage of increase was a little over 1 per cent. At the company's annual meeting 124,070 shares were represented. Benjamin Allen, F. A. Delano, C. C. Adsit and R. F. Clinch were elected directors, the latter two succeeding President D. McAllister and Clarence S. Day.

ELECTRIC RAILWAYS.

OROVILLE, CAL.—Work of surveying a line for the Northern California Electric Transportation Company has been begun.

ZANESVILLE, OHIO—The town council of Roseville has granted a franchise to the Southern Ohio Railway, Light and Power Company.

JOPLIN, MO.—A. H. Rogers, E. Z. Wollawer and A. G. Nisley have been granted a franchise by the city council of Webb City to build an electric line.

OAKLAND, CAL.—The Oakland city council has granted to the Oakland Traction Consolidated a franchise for a street car line on Linda avenue from Piedmont avenue north to the charter line of the city.

PALATKA, FLA.—Prominent citizens are agitating the formation of a stock company for establishing an electric car line from East Palatka to Hastings. It is estimated that the system could be installed for $25,000 or $30,000.

DAVENPORT, IOWA—The Davenport-Iowa City Traction Company, which purposes to build an interurban railway, through Tipton and Davenport, has been granted a franchise for its terminals in Iowa City by a majority of 1,374 votes.

TACOMA, WASH.—The Tacoma Railway and Power Company, during the coming summer, will extend its McKinley street line to Bismarck, a thriving suburb southeast of Tacoma, having a population of 1,400 people. The new line will be two miles long.

ONEIDA, N. Y.—Consents have been obtained along the highway between Oneida Castle and Sconondoah for the proposed Rome-Oneida trolley. This would make a straight road from Rome to the castle somewhat longer than the original project of entering Oneida at or through Madison street.

LORAIN, OHIO—Besides preparing to make a bid for Elyria business the Lake Shore Electric Railroad is about to extend its line to Oberlin from Lorain. Surveyors are engaged running a line from South Lorain through to that place, and a portion of the right of way has already been secured.

SHAWANO, WIS.—The Red River Valley Electric Railroad Company has made application to the city of Antigo for a franchise to construct and operate an electric railway system in the streets of the city. The line is to have connection with the projected interurban line from Eland Junction.

NEWARK, N. J.—The Public Service Corporation held its annual meeting on April 4. The company has twenty-eight directors, and they elect eight each year. The following eight directors were elected: Mark T. Cox, W. H. Hamill, William C. Heppenheimer, Lewis Lillie, J. F. Shanley, C. A. Sterling, P. Farmer Wanser, Leslie D. Ward.

SIOUX CITY, IOWA—The Sioux City Traction Company has more than doubled its original appropriation for the Sioux City improvements during the coming summer. According to the plans of the company at present the amount of money invested in improvements will exceed $400,000. Of this sum $280,000 will be expended this summer.

LA CROSSE, WIS.—An electric line between La Crosse and the Twin Cities has been proposed. The La Crosse & Northern now has franchises and right of way as far as Galesville. The project calls for the construction of the line to Galesville, and its extension to Winona. The remainder of the route is to be built by the St. Paul Street Railway Company.

BUCYRUS, OHIO—The Columbus, Delaware & Marion electric line, which is preparing to build an extension into Crawford County, has let the contract for the necessary machinery to equip its power-house just south of Delaware. The plant will be finished by July 1. Turbine engines will be installed throughout, and the equipment will be of the most modern type.

GENEVA, N. Y.—The report that the Geneva, Waterloo, Seneca Falls & Cayuga Lake Traction Company, operating an electric line between Geneva and Cayuga Lake Park, had sold the road has been confirmed. The new owners are the recent purchasers of the Rochester & Eastern. It is said the road will be rebuilt and that instead of the tracks being laid in the highway the route will be through private property.

ALBANY, N. Y.—The Findley Lake & State Line Street Railway Company, of Chautauqua, has been incorporated to construct a thirteen-mile electric railway in Chautauqua County. The capital is $130,000, and the directors are: F. R. Nicholas, of Titusville; T. E. Milkie, G. O. Elston, J. F. Austin, James R. Graves, T. H. Coggswell, Jackson Reymond, I. A. Pond, of Corry, Pa.; E. A. Austin, of Cutting. The principal office is at Findley.

INDIANAPOLIS, IND.—Work has begun on a short electric line to connect Lebanon and Thorntown. It is being constructed by the Lebanon-Thorntown Traction Company, of Indianapolis. The line will be only ten miles in length, and will serve as little more than a feeder for the Indianapolis & Northwestern. The officers of the company are: Howard M. Atkinson, of Indianapolis, president; Robert P. Woods, secretary and chief engineer; Frank M. Reed, of Indianapolis, vice-president; Richard E. Niven, of Thorntown, treasurer. Empson T. Lane, of Lebanon, is the other director.

STRATFORD, ONTARIO—At this session of the legislature application will be made for a charter to incorporate a company to build and operate an electric railway to run from Stratford to Grand Bend and Lake Huron. It is purposed to build the line through the townships of Downie, Fullerton, Blanshard, or Hibbert, in Perth County, and Usborne and Stephen, in Huron, passing through the village of Exeter. It is also contemplated to run a branch to New Hamburg, and thence to Tavistock. This railway will serve one of the finest of farming communities in western Ontario.

GRAND JUNCTION, COL.—The Grand Junction city council has approved the bond of George Smith, of Grand Junction, and C. A. Steyn, of Denver, in the sum of $15,000, the condition being that two miles of the electric line between Grand Junction and Palisades be constructed within the next eighteen months. The Grand Junction Construction Company has been organized with Judge G. Van Hoorebeke, of Grand Junction, as president, William Campbell as vice-president, and George Williams as secretary and treasurer. The latter is the county treasurer. The company will build the road.

SUFFOLK, VA.—The stockholders of the Seaboard Traction Company, which will run a trolley from Norfolk to Suffolk and Smithfield, and possibly to Richmond, has elected the following officers: L. R. Britt, president; William H. Robinson and George L. Barton, vice-presidents; George H. Lewis, general manager; W. D. Southall, treasurer; Lee Britt, secretary. An agreement has been entered into with a construction company to begin road building. The company will start operations at three points simultaneously—Norfolk, Suffolk and Smithfield. It expects to have trains running within eight months.

BUFFALO, N. Y.—The Buffalo Southern Railway Company, which was the Buffalo, Hamburg & Aurora Railway and the Buffalo, Gardenville & Ebenezer Railway, has entered into a contract with J. B. Rumsey, whereby he is to construct a first-class, high-speed railroad, from the city line of Buffalo through the towns and villages of West Seneca, Ebenezer, Spring Brook, Elma, Elma Center and Jamison to East Aurora, a distance of about thirteen miles, principally on private rights of way. It is expected that the work will be commenced immediately, and the line finished and in working order in a few months. Several prominent local business men are directors in the new company.

NEWBURGH, N. Y.—The Wallkill Transit Company, of Middletown, a reorganization of the Middletown-Goshen Electric Railway Company, has been incorporated at Albany with a capital of $350,000. The directors of the new company are: H. B. Royce and Marcus Benjamin, of Middletown; W. W. Sponsler, W. A. Sponsler, Jr., of Philadelphia; E. R. Sponsler, W. M. Ogelsby, Charles H. Bergner and W. S. Bergner, of Harrisburg, Pa., and David Hackett, of Bloomsburg, Pa. The reorganization takes over all the rights and franchises of the old Middletown-Goshen Traction Company and the Middletown-Bloomsburg Electric Company, together with the Middletown-Goshen Electric Railway Company, which was a reorganization of the two former companies.

ELECTRIC LIGHTING.

WEBSTER, MASS.—The Webster Electric Company has extended its line to Oxford.

SAN ANGELO, TEX.—Sonora, Sutton County, will have an electric light plant this year.

VUDAN, ILL.—The Vudan city council has granted a twenty-year electric light franchise to Charles W. Carr.

SIBLEY, IOWA—The Sioux City Interstate Supply Company contemplates installing an electric light system.

KINGWOOD, W. VA.—It is proposed to purchase a new dynamo and install new wiring for the town electric light plant.

JAMESTOWN, OHIO—The Jamestown Electric Light Company will install a new alternating-current incandescent dynamo.

NORTHWOOD, IOWA—The Northwood electric light plant will install an engine, two generators and switchboard apparatus.

READING, OHIO—The Reading council is preparing to call an election to vote on issuing $25,000 for improvements to the electric light plant.

CORNING, IOWA—C. K. Munns, owner of the Corning Electric Company, expects to make a number of improvements during the spring.

CARROLLTON, OHIO—The Carrollton Electrical Company will in the spring add a new engine, dynamo and boiler. E. L. Swann is manager.

TACOMA, WASH.—An electric lighting and power plant will be built by the Equitable Finance Company, of Portland, on the Nisqually river. It will cost $750,000.

KELSO, WASH.—The council has granted to the Kelso Light and Power Company a twenty-five-year electric light franchise. The plant is to be in operation inside of six months.

ROSSLAND, B. C.—The West Kootenay Power and Light Company has commenced an elaborate scheme of development of the upper falls of the Kootenay river at Bonnington.

MASSILLON, OHIO—Press reports state that it is proposed to bond the city for $500,000, to be used for the construction of waterworks, an electric light plant and city hall.

NEW YORK, N. Y.—The Westchester Lighting Company is supplying Mount Vernon with electricity from its plant in Eastchester. The old works in that city have been discontinued.

READING, PA.—A five-year lighting contract has been awarded to the Metropolitan Electric Light Company. It is for arc and incandescent lights, illuminating city hall and the police patrol wagon stable.

DOYLESTOWN, PA.—The Georgetown, S. C., Electric Light Company's plant has been sold to Harry Case, of Newtown, Bucks County, for $60,000. The concern was capitalized at $30,000, and bonded for $40,000.

BUTTE, MONT.—It is reported that a deal has been closed whereby the Butte Electric Light and Power Company becomes the owner of the property of the Bozeman Company, having bought out the latter corporation.

SALIDA, COL.—The Edison Electric Company has been granted an eight-year franchise, by the Salida city council, to furnish the city with lights. The company has commenced work on a large power plant which will require the expenditure of $100,000.

RENFREW, ONT.—The new electric lighting and power plant built by the town of Fenelon Falls at a cost of $30,000 is now in running order. The work, which was begun early last summer, involved the construction of a concrete dam 200 feet long.

NIAGARA FALLS, N. Y.—The Canadian Niagara Power Company, it is reported, may erect a power transmission line toward Queenstown. It is said the power-house of the Niagara Falls Park and River Railway, at that point, will receive current over the new line.

BAYONNE, N. J.—A bill has been introduced in the New Jersey legislature, at the instance of Mayor Thomas Brady, authorizing the city of Bayonne to erect an electric light and power plant. The bill contains a referendum clause, and is applicable to any municipality.

BAKER CITY, ORE.—It is stated that eastern interests have purchased the Baker City electric plant for $400,000. The plant is located on Rock creek, about twenty miles from the city, and has a capacity of 1,500 horse-power. The only improvement to be made this year is the extension of the power lines to more distant properties.

DECORAH, IOWA—The Decorah Electric Light Company purposes developing a water power and transmission line to operate its Decorah plant, and one at Waukon. There will be required, besides a dam, two 200 to 250-horse-power wheels, two 128-kilowatt, 6,600-volt, three-phase, sixty-cycle generators, and 250 kilowatts in transformers.

SAN FRANCISCO, CAL.—The board of supervisors of Inyo County, Cal., has granted a franchise to W. E. Condon, representing the Owens River Light and Power Company, to construct and operate electric systems along the public highways. The work of construction is to begin within six months and must be completed within eighteen months.

FLORENCE, COL.—The board of trustees of the town of Rockvale has granted to the Arkansas Valley Electric Company, of Florence, a franchise, giving it the privilege of erecting poles and stringing wires within the town limits, for the purpose of furnishing electricity for light and motive power. The franchise is for one year, with the privilege of renewal.

CHARLOTTE, N. C.—It is stated that the Mountain Island Power Company, which owns the Mountain Island mills, 1,100 acres of land and the water rights along the Catawaba river for several miles, has been sold to a party of capitalists headed by W. G. Wylie, of New York, the purchase price being $300,000. It is stated that the purpose of the new company is to furnish power to a large number of mills in adjoining counties.

OTTAWA, ILL.—The waterworks and electric lighting systems of Marseilles are now under control of a new corporation, known as the Consolidated Water and Light Company. Heretofore the waterworks and street lighting systems have been operated by the Water and Light Company, and the incandescent system by the Land and Water Power Company, both owned by W. D. Boyce. The new syndicate is headed by John M. Nicholson.

PITTSBURG, PA.—The Mifflin Light and Power Company, which was granted a charter recently, has commenced work on its power-house in Mifflin township, the cost of the power-house being estimated at $30,000. The company was about a year ago granted a franchise by the Homestead council. The directors are the owners of the Homestead & Mifflin Street Railway Company, which operates a line from Homestead to Lincoln Place, in Mifflin township.

PORTCHESTER, N. Y.—The certificate of election of directors of the Westchester Lighting Company has been filed in White Plains. It shows that the following directors were chosen for the ensuing year: W. R. Addick, L. L. G. Benedict, James C. Brady, Harold Brown, R. A. Carter, H. E. Gawtray, William E. Hall, Thomas E. Murray, W. W. Screwgham, John W. Sterling, F. A. Stratton. There were 1,363,989 votes cast; each director received 123,999 votes.

NEWARK, N. J.—The annual meeting of the board of directors of the United Electric Company, of New Jersey, which the Public Service Corporation absorbed, was held recently, and all the officers of the concern were reelected as follows: president, Thomas N. McCarter; vice-president, A. B. Carlton; treasurer, James P. Dusenberry; secretary, Frederick Evans. Directors were reelected as follows: John J. Burleigh, Thomas C. Barr, Mr. Carlton, A. R. Kuser, T. N. McCarter, Uzal H. McCarter, Charles A. Sterling and John I. Waterbury.

WATKINS, N. Y.—Justice Albert H. Sewell has granted a judgment of foreclosure and sale in the case of the People's Bank of Wilkesbarre, Pa., *vs.* the Watkins Consolidated Gas and Electric Light Company. Charles M. Woodward, of Watkins, the referee named for that purpose, will sell the property of the company at the court house, April 21, to satisfy the claim which approximates $108,416.69, to which must be added interest from March 6, 1905, and court allowances. The property consists of three parcels of land, with gas and electrical equipment and all rights of way, powers, privileges, franchises and contracts granted to and enjoyed by the defendant company. The electrical plant of the company was practically destroyed by fire a few weeks ago.

INDUSTRIAL ITEMS.

THE NEWARK GAS ENGINE COMPANY, 220 Broadway, New York city, will be pleased to send descriptive matter and a list of users of its gas and gasoline engines.

THE AMERICAN STEEL AND WIRE COMPANY, Chicago and New York, is distributing a valuable leaflet entitled "Sulphate of Iron in Agriculture." This bulletin has been compiled by H. E. Horton.

C. W. HUNT & COMPANY, New York, have issued catalogue No. 053, describing the Hunt noiseless conveyer and accessories. The book contains a large number of photographs and line-cuts, illustrating the application of the conveyer in numerous power plants.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., is distributing catalogue No. 119, describing machinery for cement making. Processes are described, and complete plants are shown. All types of mills and other machinery used are described and illustrated.

THE ARCHBOLD-BRADY COMPANY, Syracuse, N. Y., announces that it has removed its offices to temporary quarters at 237 James street. After May 1 it will occupy permanent quarters in its new structural shop at Greenway avenue and the West Shore railroad.

THE HOWARD MINIATURE LAMP COMPANY, 58-60 Reade street, New York city, has issued a new catalogue on miniature lamps. Nearly sixty types of miniature lamps are illustrated. This company is also about to place on the market a new line of medical batteries.

THE RELIANCE MACHINE AND TOOL COMPANY, Cleveland, Ohio, has printed a new catalogue describing Reliance bolt threading, pipe threading, nut-tapping machinery and accessories. Illustrations are given in half-tone and in diagram, and the apparatus is fully described.

THE NATIONAL BATTERY COMPANY, Buffalo, N. Y., is distributing a booklet, illustrating the various types of storage batteries made by this company. These include batteries for power station, for telephone work, railway signal systems, car lighting, gasoline ignition and electric vehicles.

THE DIEHL MANUFACTURING COMPANY, Elizabethport, N. J., has brought out catalogue No. 16, describing the direct-current fans made by this company. These include ceiling, electrolier, column, desk telephone booth and counter fans. The catalogue contains about thirty pages, and is very attractively got up.

THE ELECTRIC GAS LIGHTING COMPANY, 115 Purchase street, Boston, Mass., is distributing an elaborate catalogue descriptive of its telephone and annunciator practice. This work gives a few examples of representative installations. The book is handsomely printed, and the references are complete and easily understood.

THE L. B. ALLEN COMPANY, INCORPORATED, Chicago, Ill., is calling attention to its "Sun" soldering stick. This material is for work that demands good solder, but where it will not pay to use high quality flux. The "Sun" soldering stick makes a strong, quick joint, keeps the solder tight, saves scraping, and gets in under the dirt and rust.

THE GRIGGS MANUFACTURING COMPANY, 79-81 Fifth avenue, Chicago, Ill., will be pleased to send its descriptive matter relative to the Griggs improved desk telephone-holder. This holder is made in three styles of finish—black japaned, copper oxidized and nickel-plated. The holder is very simple in construction, and is claimed by the manufacturer to be very durable and of great practical value.

THE DIAMOND-STONE BRICK COMPANY, Wilmington, Del., announces that it has closed contracts in Philadelphia for over 5,000,000 of its new Diamond-Stone brick, which is manufactured on the sand-lime principle. The company states that it makes a large variety of special colored bricks, and also spotted and rough bricks, which are especially recommended for resistance to severe weather.

THE WATERBURY BRASS COMPANY, Waterbury, Ct., has brought out a new catalogue. This catalogue contains complete tables and weights of seamless-drawn brass and copper tubes, and brazed tubes; also brass and copper in rods, wire and sheets. Tables, which are short-cuts in figuring on tubes, are also given. A complete list of the stock carried on hand is also incorporated in the catalogue.

THE NEW YORK TELEPHONE COMPANY, 15 Dey street, New York city, is distributing a handy reference calendar. This calendar has been devised for handy reference to the last and coming month, as well as to the present month. The company also reminds one that the use of the telephone has not been sufficient in the past, and that the present is the proper time to provide for the telephone facilities of the future.

THE NORMAN W. HENLEY PUBLISHING COMPANY, 132 Nassau street, New York city, has brought out a boiler-room chart which sells for twenty-five cents. The chart is a drawing in isometric perspective, and shows all the mechanisms in a modern boiler room, arranged in their proper relation to each other. The various parts of the different appliances are numbered, and a reference table, giving their correct names, is printed on the side of the chart.

THE NATIONAL ELECTRIC COMPANY, Milwaukee, Wis., manufacturer of Christensen air brakes and electrical machinery, will remove its New York city offices to a new suite on the twelfth floor of the Trinity Building, 111 Broadway, one of the largest and most modern buildings in the city. The present quarters of the company at 135 Broadway are too small to accommodate the increased sales organization. The Trinity Building will be ready for occupancy about May 1.

THE UNITED TELPHERAGE DEPARTMENT, DODGE COAL STORAGE COMPANY, 49 Dey street, New York city, will be pleased to send circular No. 55 upon request. This circular describes and illustrates telpherage equipment for transporting machinery, castings and general merchandise from one part of a works to another. This circular illustrates a number of typical instances where telpherage equipment has been installed, greatly improving the efficiency of the operation of conveying parcels from one point to another.

THE NATIONAL CONDUIT AND CABLE COMPANY, 41 Park row, New York city, manufacturer of bare copper wire, weatherproof wires and cables, lead-covered wires and cables for telephone, telegraph and electric and power work, has issued its bulletin, "Copper Gossip," dated March 20. This bulletin gives notes on the general business outlook, the copper market situation, the London copper market, New York and London copper prices, exports of copper, imports of copper, copper mining news and developments, and European copper statistics.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is sending out to the trade a new price list dated April, 1905. This price list applies to the company's 1903 catalogue. This combination should be secured by every one interested in buying electrical material. On the title page of the price list is shown a view of the company's new location at 207-211 East Jackson Boulevard, and on the back page a picture of the ruins of the old building at 264-270 Fifth avenue. The book contains the latest prices in force, and the company requests the holders of its catalogue who have not received a copy to write for one at the earliest possible moment.

THE WIRT ELECTRIC COMPANY, 3108 Germantown avenue, Philadelphia, Pa., has distributed circular No. 316, describing and illustrating the Wirt theatre dimmer. The Wirt dimmers have a metallic resistance, and are entirely enclosed in iron cases, making them practically fireproof. They have fifty steps, which are tapered to take care of the variation in amperes, and have a laminated switch, ensuring easy movement and good contact. They require 180 degrees movement to cut the resistance either in or out. These dimmers are made in various forms for installation on the wall, for dimmer stands and either interlocking or non-interlocking.